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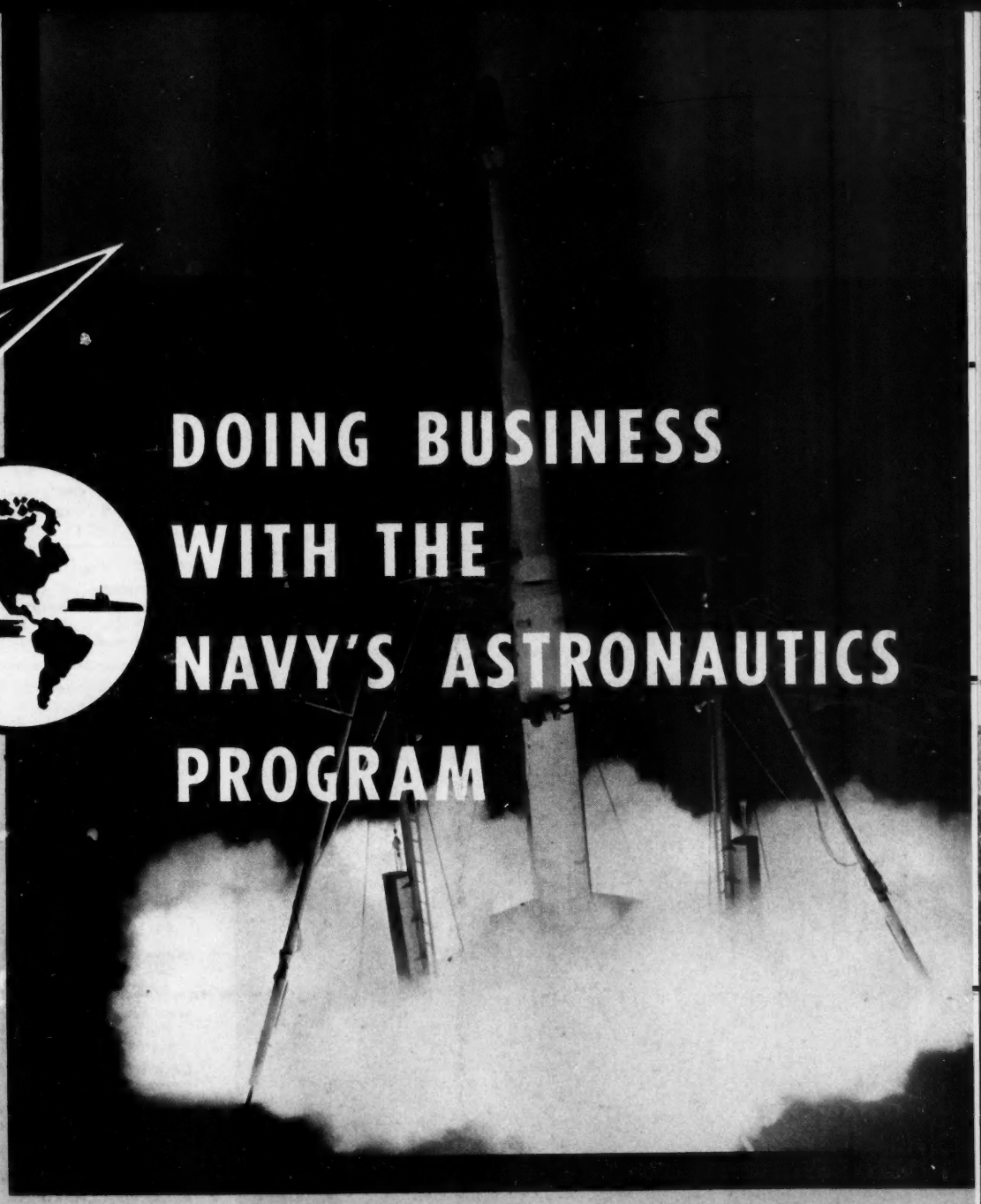

DOING BUSINESS WITH THE NAVY'S ASTRONAUTICS PROGRAM

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August 1960

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Lockheed X-17A guided missile Number 2 being fired from fantail of USS NORTON SOUND.

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DATA

• GERMAN-AMERICAN ISSUE

SIR:

The German Embassy in Washington is very much interested in your suggested project of devoting an issue of DATA to the subject of American-German defense relations. There would be constructive cooperation from our side. The Embassy's Press Office and the Press Section of the Federal Ministry of Defense in Bonn will make available any kind of information needed to make this issue of DATA a full success.

Robert Borchardt
Press Secretary
Embassy of the Federal Republic of Germany
Washington, D. C.

SIR:

This is to advise you that Julius Klein Public Relations will be happy to cooperate with DATA Publications in organizing a special issue of DATA magazine to be devoted to the subject of West German-U. S. Defense Partnership.

We are pleased to learn that the Embassy of the Federal Republic of Germany in Washington has also endorsed the idea which came from our office for DATA to devote an issue to this vitally important subject of American-German defense relations.

We look forward to working with you on this special edition.

Kenneth Buchanan
Major General, USA (Ret.)
Vice President and General Manager
JULIUS KLEIN PUBLIC RELATIONS, INC.
Washington, D. C.

Ed.—Following our initial mention of the possibility of doing a German-American edition in this column last month, reader interest has been strongly in favor of such an edition. We are therefore going ahead with the German-American Defense Partnership issue of DATA. It is planned for a May 1961 release. We would appreciate receiving readers' comments and suggestions.

• DEFENSE MARKETING FORUM

SIR:

Your new feature "Defense Marketing Forum" by Patrick Thomas is excellent. It adds even greater value to your outstanding publication. Are copies available?

We shall be looking forward to receiving the July issue containing information on "Market Intelligence." Please keep this feature coming.

T. L. Shubert
Manager, Market Research
GOODYEAR AIRCRAFT CORPORATION
Akron 5, Ohio

Ed.—Reprints of "Defense Marketing Forums" are available at 25 cents each.

• GENERAL COMMENTS

SIR:

I recently subscribed to Data Publications for your monthly DATA magazine and am very pleased with it. My principal regret however is that I did not get started on it sooner.

The issue currently in my hands dated June 1960 is most satisfactory for my purposes. How may I go about getting the five previous issues for 1960? If the entire magazine is not available, the DATAGRAF "Chart-of-the-Month" will be sufficient. Please let me hear from you on this as soon as possible.

Gordon A. Moos
Assistant to the Vice President
WALDES KOHINOOR, INC.
Long Island City, New York

Ed.—We generally maintain only a small supply of back issues. We have, therefore, sent Mr. Moos the charts he requested.

SIR:

On a recent visit to the Pentagon we learned of the existence of "Data Publications," and were impressed with what we saw of your work. As the service you appear to perform is one which we probably could utilize, we are anxious to secured detailed information on what type of information you are able to furnish, areas that you cover, various forms it can be presented in such as tabulations, charts or graphs, and whether you publish a newsletter or magazine on specific areas of interest at regular intervals. This information together with respective costs for such services would be appreciated.

As we are expanding into several new areas of activity presently, we shall be looking for an early reply to our inquiry so that an evaluation of your services can be made which we trust will result in arrangements being made that will prove mutually advantageous.

M. I. Beers
Target & Drone Manager
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Ed.—So how much evaluating can you do before spending one buck a month?

SIR:

As regular subscribers to DATA Magazine we have found your publication most helpful. The June 1960 issue of DATA is particularly good and we would appreciate receiving one additional copy of this issue. Would you kindly send this to: Mr. Robert H. Stevenson, Flexible Tubing Corporation, 136 West Second Street, Dayton 2, Ohio. Thank you very much.

Lochlin G. Syme
FLEXIBLE TUBING CORPORATION
Guilford, Connecticut

AUGUST 1960

data*

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A brief message from the publisher:

We are very pleased to present this Navy Astronautics issue of DATA. This edition contains an insight into the Navy's vectors of future effort in the field of space technology, biographical sketches of the key Navy Astronautics personalities, descriptions of current Navy space projects, field activities contributing to the Naval Establishment astronautics program and other useful information for those readers now in this sector of endeavor or those contemplating involvement. We liked working on this issue, liked the people we worked with and want to thank all the fine officers and men in the Navy Astronautics program who worked with us on this edition.

MURRAY SMITH

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NEXT MONTH IN DATA

The September issue of DATA will feature the U. S. Army Signal Corps.

Special Message from CNO

The Navy feels that the pursuit of space projects can assist the accomplishment of its assigned missions. In addition, since there is a good probability that a potential enemy could use space to interfere with our operations, the Navy's space activities are directed toward making space work for us and to prevent anyone from using it against us.

There are other reasons also which make the use of space very valuable to Navy operations. Aids to navigation, of course, is one of the most obvious areas of interest for the Navy space program, and it is in this field that we are concentrating most of our present effort. As you DATA readers know, the Navy was assigned the TRANSIT project which consists essentially of a navigational satellite for military use.

We have also developed the satellite detection system which is used by all the military services as well as other scientific groups.

There are other areas of space in which the Navy is vitally interested. These are primarily in surveillance, weather, and detection of space vehicles. Another very important project in which we are interested is a communications satellite.

I would like to point out that the Navy's contribution to the space program supports the national effort in this very important area and coordinates Navy programs with the other services, Department of Defense and NASA.

The Navy will continue to be very interested in space.

Arleigh Burke

ADM. ARLEIGH A. BURKE
Chief of Naval Operations

FEATURE EDITORIAL

DATA/Navy Astronautics Issue

WHO BOOSTS NAVY BOOSTERS?

by Martin Caidin/DATA

The major bid by the United States Navy for a prominent role in the astronautics programs of the country is a move unique in its method of presentation. The usual claim to specific roles and missions in space carries with it extensive noise in Congressional hearings, accusations and counter-accusations, and the flying debris of the political circus.

The requirements of astronautics to fulfill the basic mission of the Navy, however, is unique—successful astronautics programs carried out either directly by the Navy, or under Navy control, are absolutely necessary in order that modern weapons, notably the POLARIS system, be utilized to maximum efficiency. Instead of first making a major *public* bid to wrest some control and authority from the Air Force, the Navy instead first demonstrated in dramatic fashion the critical and intrinsic values of its POLARIS-submarine system. The fact that to be fully accurate, the POLARIS must have TRANSIT satellites placed with infinite precision in space, is not going to be overlooked by those people who decide financial budgeting and administrative control—*and the Navy is going to be absolutely certain that it is not overlooked.*

And more power to them. Through its Office of Naval Research, the Navy and its scientists have performed wonders in basic research, and in pioneering steps into space at a time when public support was nil, official blessings a vainly sought-for miracle, and funds little more than the barest dribble.

The critical need for the *meeting of requirements* of astronautics programs for the United States Navy simply isn't going to be met by the parceling out of missions to the Air Force, to NASA, or to an organization equivalent to ARPA, which saw a truly brief heyday in space. USAF has a critical need for continuing success and advancement in space in order to fill its own roles and missions, and if Navy is required to wait upon the success of Air Force programs, it might run into the unavoidable snags of delays, failures, slipped schedules and the normal problems of this rather unpredictable rocket field.

Shall NASA launch the Navy's satellites? But NASA is strictly, by definition of the law of the land, dedicated and restricted to the pure-white scientific-civilian role in space. The President has said so, many times, in fact—never the twain of military and scientific missions shall meet in space.

And right here lies the crux of the Navy's unforgivable situation—through no fault of the Navy—of going begging for a self-sustaining astronautics capability of its own: *not* to explore space or to duplicate the activities of other agencies, but simply to carry out its mission with the greatest military efficiency on the surface and within the atmosphere of the earth.

It goes back to the days when decisions had to be made that would affect our capabilities in astronautics for many years to come, when the President of the United States donned rose-colored glasses and insisted that there must be a distinction between military and civilian space programs, and that to use military rocket vehicles for placing scientific instrumented packages in space might be regarded by the little nations around the world as something reprehensible. *Those were the days when the Air Force begged the White House to allow the Navy to take a number of THOR boosters for the faltering VANGUARD program and so get us into the space business in a hurry!*

How times have changed! Everything going into orbit today is kicked out of the atmosphere with one of those nasty military boosters, and even the new SCOUT has evolved from standing military requirements of SPR boosters. Its just the reality of the picture—a booster has only one job, and that is to lift weight at great speed along a proper trajectory. It doesn't matter what you *name* the booster.

So here we are at a new impasse: who fulfills the astronautics-booster role for Navy, on a continuing, major program, which needs a major capability for carrying out its military mission?

We haven't been able to find the answer to *that* question.

—MARTIN CAIDIN

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DATA Interview with Admiral Hayward

VICE ADMIRAL HAYWARD
DCNO for Development

Q. Admiral Hayward, DATA would like to know if the TRANSIT Navigation system will be available to other countries?

A. The answer is yes. The satellites in orbit will be transmitting signals for any ship under any flag to use. Of course, it would be necessary for them to install certain equipment.

Q. Where would they get such equipment?

A. Once the system is designed, industry will, of course, provide for production for Navy use through normal Bureau procedures. Equipment for private shipping would also come from industry through the normal marketing channels.

Q. Does the Navy plan to conduct its astronautics development "in-house"?

A. We will use both our own laboratories and industry. The Navy has no "astronautics laboratory" as such. The various Bureaus in developing space systems will most certainly make full use of the resources of industry. For example, Bendix built and operates our Space Surveillance Receivers as a full partner to our Naval Research Laboratory.

Q. Does the Navy have a "man-in-space" program?

A. The Navy is supporting the NASA "Mercury" project one hundred percent. The Navy's bio-astronautics facilities at Johnsville and Pensacola are unique and are being fully used; fleet units will be used in the capsule recovery; four of the seven astronauts are naval aviators. In other words, we are participating fully in the National Program.

Q. What do you see as the major problem areas in space technology?

A. Well for one thing — reliability. We hope to develop satellites that will function for years without maintenance or replacement of parts. A great deal of research and development will be required on components and systems to achieve this. Redundancy and "self healing" circuits may be part of the answer. Also we need constant, long lasting and reliable power sources and of course, with it all we need to reduce weight. The Navy's space program is based on small simple payloads in order to gain in reliability.

Q. How do the so-called "high altitude probes" fit into the Navy space program?

A. The launching, payload recovery and electronic read-out for probes will be very similar to those needed for small satellites. Probes would in many cases be cheaper and for certain tactical situations could do the job better than satellites. The two programs complement each other. We are very much interested in the use of tactical probes.

Q. We have heard that Vandenberg AFB and Pacific Missile Range are in competition. What is your view of the alleged differences that have existed on the west coast?

A. Well, in our view the roles of the two facilities are very different. Vandenberg is intended to support operational squadrons in their training with ballistic missiles. It is true that some of the facilities at Vandenberg have been used in the conduct of research and development while these facilities were available and could be spared from the training mission. On the other hand, the facilities at Pacific Missile Range at Point Arguello are intended for support to R&D programs being conducted by the military departments and by NASA. The extent of the Department of Defense responsibility in PMR has been recently extended with the transfer of the Eniwetok Proving Ground from the Atomic Energy Commission.

Q. Has the Navy engaged in any studies concerning various means of transporting large boosters?

A. We have looked at a number of methods for transport of large boosters; if we consider the Saturn as an example, we can see that it will be water-borne for most of its life. Although manufactured on land and launched from a land site, it spends the rest of its time on barges being towed across the various waterways. Other methods have been considered, such as possible use of airships, but a quick look at the lifting capacity of either aircraft or airships will indicate that a complex process would be involved of either several airships or complete breakdown of the missile into so many components as to provide very complex manufacturing and assembly problems. Simply, we feel that water transport is the most convenient, economical, and safe method of transport of very large boosters.

Q. Do you feel that these large boosters will eventually be fired from, as well as transported on, the surface of the water?

A. We certainly do. We feel that the advantages to be realized from launching huge boosters from the sea are tremendous. We feel that this would afford advantages in flexibility, safety, security, ease of handling, and many others, However, we do not consider this to be a tactical application of space vehicles, but rather see the Navy as performing this function for other agencies; for example, NASA in its space travel explorations.

Q. The Navy has stated that it wants to see smaller payloads for satellites so that boosters can be reduced in size. How do you know this can be achieved?

A. Aside from obvious improvements such as increased propellant efficiency, decreased booster casing weight, and improved miniaturization of payload components, there are other techniques which can be used to decrease the size of the satellite itself. The most obvious is to employ fairly simple, single-purpose satellites requiring a minimum of complex stabilization, readout, etc. If the payload can be recovered, it may require certain mechanisms for the recovery package, but it will reduce the requirements for data transmission. Simply, there is a tradeoff process of putting in the satellite or in the ground station the necessary mechanisms to get the data back in usable form to the consumer.

Q. There have been a number of proposals for changing the National Space Act and this is now under consideration by Congress. Do you feel any changes will be made in the immediate future to afford an improved organization for our U. S. space effort?

A. This particular problem has been under consideration for some time. I have testified as to my views on the possible organizational solutions that could be adopted to improve the working arrangements for space. I feel, however, that the important factor is not the precise type of organization that is achieved, but rather the spirit with which we undertake our space program. The current changes that have been asked for by the President and are being considered by the Congress will afford improvements in streamlining the organization for space and clarifying certain responsibilities. However, due to other complications relative to patent practices and similar problems this legislation may not be enacted this year.

U. S. Navy
Astronautics Program

MISSION

The Navy will use space to accomplish naval objectives and to prevent space from being used to the detriment of those objectives. Through pursuit of necessary research and technological developments, the Navy will enhance its ability to conduct operations in space which are in support of its roles and missions and which contribute to the welfare of the nation.

BUDGET

The Navy Budget for Research, Development, Test and Evaluation will average about one billion dollars per year, and an increasing portion supports the astronautics program. However, up until this year all space applications were funded by the Defense Department rather than the services. As a result of recent DOD directives assigning direction of space applications programs to the services, the Navy plans to spend about $25 million on satellite systems in FY 61 and approximately double that beginning in FY 62.

POLICY

Space is a medium that holds great promise and, at the same time, great threat for the U. S. and the Free World. The Navy will use space to accomplish naval objectives and to prevent space from being used to the detriment of those objectives. Specifically, the Navy will pursue the necessary research and technological developments which will enhance its ability to conduct operations in space which are in support of roles and missions presently assigned to the Navy.

The Navy will participate fully in space technology in order to contribute the tremendous resources of the Navy to the national effort, including the logistical and operational advantages which can be gained by maritime support to space operations and development programs. In the interest of economy and efficiency, it will pursue, in partnership with the other services, the technological developments which will permit the defeat of space operations of other nations which threaten the U. S. The Navy will also vigorously support national civilian space programs, to which the Navy's unique capabilities can provide significant contributions.

The Navy astronautic program will receive high priority in the overall Navy research and development program.

Approved:
Chief of Naval Operations

REAR ADMIRAL C. B. MARTELL

Question: Admiral Martell, Do you have a message for DATA readers in the Defense-Industry complex who are interested in the Navy's space and astronautics program?

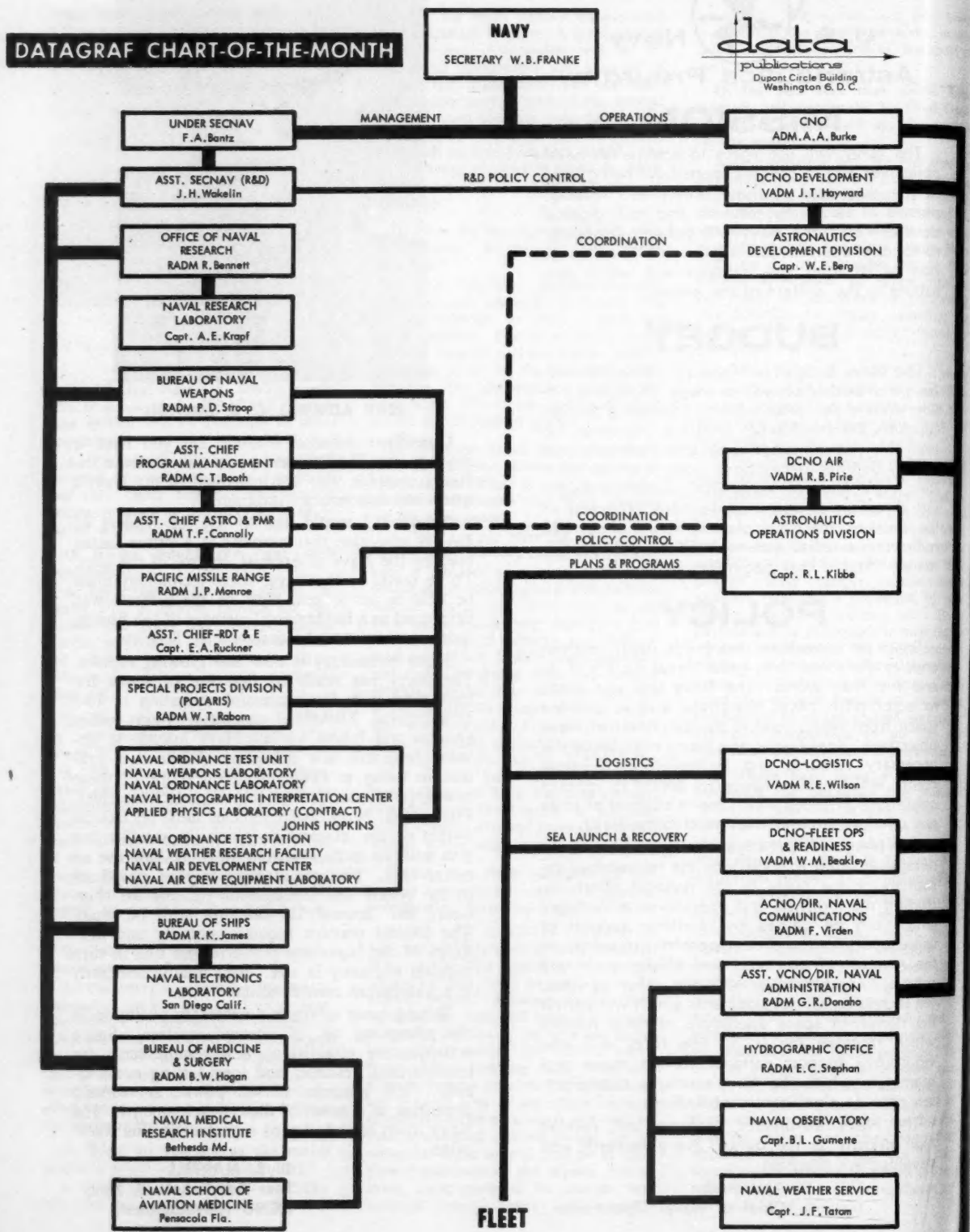
Answer: I would like to tell the readers of DATA magazine that mobility is a prime factor used by the Navy to exercise control of the seas. To be useful to the Navy, space technology must be able to go to sea. Just as the aircraft was developed as a fundamental element of sea power, space systems must be designed for fleet use.

Space technology is new and growing rapidly. The Navy has made its first use of space for navigation with the successful operation of two experimental TRANSIT satellites. Many other systems will follow for the Navy intends to develop fully this new discipline. While it is premature today to define the total scope of these new applications, certain characteristics are clear. First of all, Navy space vehicles must be tactical —that is, the information which the satellite can give must be made available for immediate use on board ship. This requirement implies simplicity in the system and installations suitable for shipboard use. Second, the satellites must be small. The tactical concept requires mobility and flexibility of the launching platform and this in turn requires economy in size. And finally, reliability is a paramount consideration.

Taking space to sea is a necessary evolution in the advancing art of oceanic warfare. Space activities are establishing new requirements for miniaturized, reliable, and long lasting components. New horizons of sea power are rapidly appearing as a result of these developments. The Navy looks to industry as a partner in this enterprise.

C. B. MARTELL
Rear Admiral, U. S. Navy
ACNO (Development)

NAVY ORGANIZATION FOR SPACE



Navy Organization for Astronautics

THE SECRETARY of the Navy along with his other responsibilities holds the initial and final authority over the Astronautics Program of the Navy. It is his responsibility to interpret the National Policy, as determined by the National Security Council or the National Aeronautics and Space Council, to Navy purposes. The President, the Secretary of Defense, and the Administrator, National Aeronautics and Space Administration are all concerned with space matters, and at this level the Secretary of the Navy provides the basic guidance and makes those decisions which will effect the scope and extent of the Navy Astronautic Program. This function of course is not entirely executed personally by Mr. Franke, since he is aided by his Under Secretary and the Assistant Secretaries in their specific areas. Thus, the most active civilian authority in the Navy's space program is the Assistant Secretary of the Navy for Research and Development, Dr. James H. Wakelin. Not only does Dr. Wakelin have direct authority over the Office of Naval Research and the Naval Research Laboratory, but he is also the primary channel to the Department of Defense R&D organizations and the principle point of contact for the Deputy Chief of Naval Operations for Development, Vice Admiral Hayward.

Organizational Concept

In the Navy's organizational concept, there are two distinct branches which have cognizance over the Navy's various functions; the operational side under the Chief of Naval Operations and the management side headed by the Under Secretary. Here rests the control over the Bureaus which perform the technical support to the Navy's space program. It is the function of the Bureaus to provide the feasibility studies, the technical development plans, the program management, the contractural work, and the procurement which is required in the execution of the Navy astronautic efforts. Although the Bureau of Weapons has more astronautics projects than any other Bureau at the present time, the Bureau of Ships, the Bureau of Medicine and Surgery and the Bureau of Yards and Docks are all very active in their own specific fields in naval astronautic applications. Supporting the various Bureaus are their laboratories which perform the basic and applied research, development, test and evaluation of various systems. Essentially, the technical Bureaus and their laboratories provide the integration that is needed to bring into being the astronautics systems for the accomplishment of Navy missions. Behind their work of course is the Office of Naval Research and the Naval Research Laboratory which are concerned with the many broad areas of basic research.

The policy direction, control, technical management, logistic support and similar functions provided by the Secretaries, the Bureaus and the Laboratories are essential for the accomplishment of the Navy's space programs. The only purpose of all this effort, however, is to provide systems for the military side of the organization which is concerned with operations of the fleet. Basic military guidance for space matters is provided by the Chief of Naval Operations, Admiral Burke, and by his various Deputies who are charged with responsibilities ranging from logistic support to fleet readiness. It is at the Deputy level that the policy guidance provided by the Secretary and by the Chief of Naval Operations is translated into naval policy.

Deputies

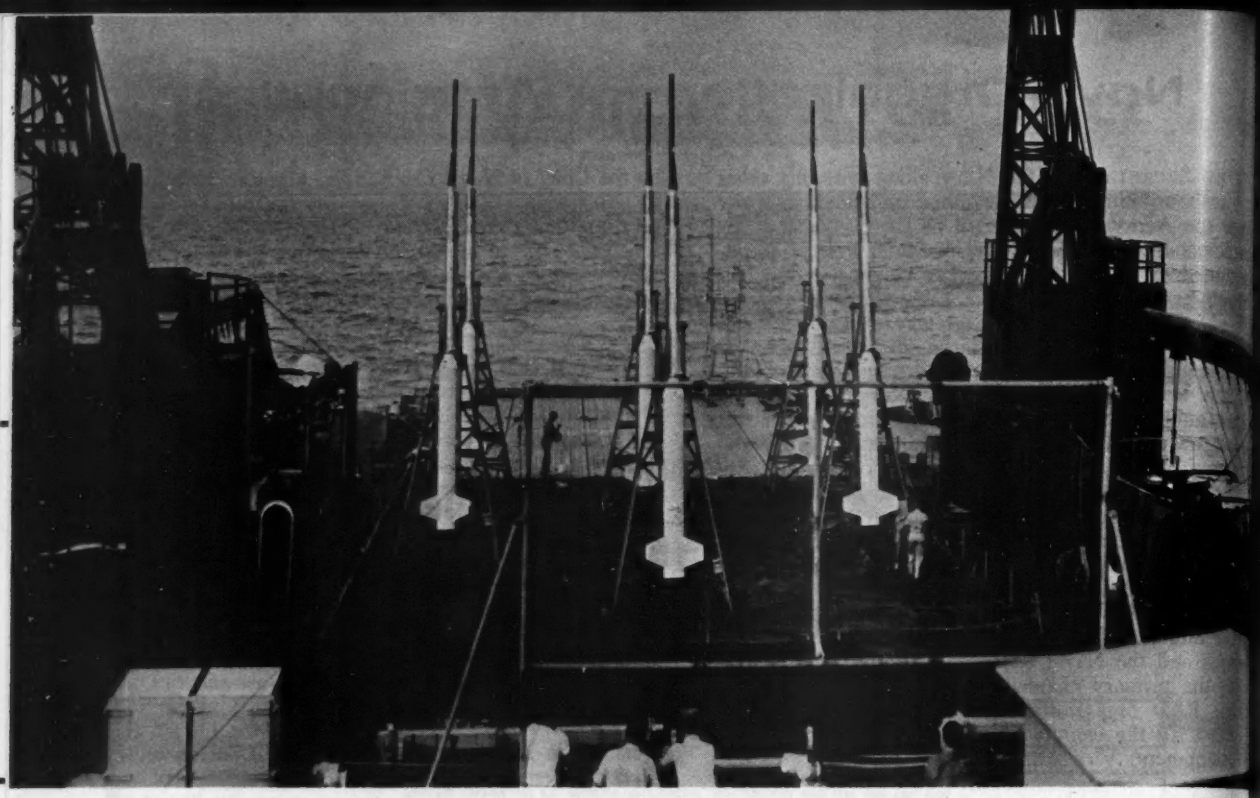
The two Deputies who are primarly concerned with astronautics programs are the Deputy Chief of Naval Operations for Air, Vice Admiral Pirie, and the Deputy Chief of Naval Operations for Development, Vice Admiral Hayward. Just as the various other operations of the Navy are represented by "warfare desks" in the Office of the CNO, so does the Astronautics Operations Division headed by Captain Kibbe represent the various users of astronautics systems. It is this office which has the primary responsibility for the generation of requirements for space techniques in order to obtain Navy objectives. In communications, navigation, intelligence and weather, space programs are defined for development by the R&D division for astronautics.

Astronautics Development

It is the Astronautics Development Division under Captain Berg which takes the basic research of the Office of Naval Research, the concepts developed by the laboratories, the long range plans from the Deputies and the Requirements as presented by the Operations Division and translates these into astronautics developments to provide eventual operating systems. The major supporter of the Astronautic Development Division in budget matters and similar functions is Admiral Joseph Jaap in his capacity as Director of Development Programs in OPNAV. It is his responsibility to weigh the astronautics program as to its adequacy to accomplish Naval objectives and to review its coordination with the other areas of strike warfare, anti-air warfare, and with various supporting programs. He must insure that the monies and facilities available are adequate to support the broad scope of the Navy's research effort in many fields.

Offices Having Greatest Influence in R&D

If one were to choose the offices of the Navy Department having greatest influence in the Navy astronautic Research and Development Program, the spotlight would fall on the Assistant Secretary of the Navy for R&D, Dr. Wakelin; the Deputy Chief of Naval Operations for Development, Admiral Hayward; the Astronautics Development Division, Captain Berg; the Assistant Chief of the Bureau of Naval Weapons for Astronautics and PMR, Admiral Connolly; and the Astronautics Officer of BUWEPS, Captain Freitag. These officers are greatly concerned with the pursuit of Navy astronautics and with its orderly introduction into the operating fleets. The Navy has a firm belief that astronautics should not exist purely for its own sake, but rather as a means to support the basic missions and functions of the Navy; the R & D program and organization are designed to execute this concept. ■



Rocket astronomy made its eclipse debut with considerable success during the Navy-IGY scientific expedition to the Danger Islands of the South Seas to observe the solar eclipse of October 12, 1958. Pushbutton fired by Naval Research Laboratory scientists from the helicopter deck of the USS POINT DEFIANCE within a span of 38 minutes, five data-gathering rockets shot far above any interfering cloud cover to map the sun in wavelengths of X-rays and ultraviolet light.

Why the Navy Has a Space Effort

Prepared by Naval Astronautics personnel

WARS, as we know them today, are waged between inhabitants of the earth over issues which exist on the earth. The use of space for military purposes must therefore be directed, at least for the discernible future, toward contributing to the favorable resolution of conflict on earth. With the oceans covering so much of the earth's surface, and with United States territory constituting less than 2 percent, space operations designed to observe, influence or control activities on the earth's surface are of major naval interest.

Technologics which are leading toward use of space for military purposes are also leading toward use of the ocean spaces to a greater degree than ever before. The increasing accuracy of ballistic missiles against fixed bases, for example, is forcing the removal of a greater proportion of our Nation's striking power from within our own territory into the vast oceanic areas.

For these and many other reasons United States security depends to a greater degree than ever before on the ability of the Navy to secure and utilize the world oceans.

The Navy has long recognized the influence which future space operations will have on Naval effectiveness and has been in the forefront as a contributor to our Nation's accomplishments in space. The Navy's storehouse of practical experience and know-how in electronics, aerodynamics, rocket propulsion, cosmology, human engineering, aviation medicine, and a host of other areas has made major contributions to the national space effort.

SUPPORT TO NATIONAL EFFORT

The Navy's space organization, capabilities and goals did not develop over night, did not suddenly leap into being when the first Sputnik was launched, nor were they generated by Project Vanguard. All of these have been the result of a long process of evolution that has gone on for many years. The very nature of the complex warfare conducted by the Navy has necessitated that it look to new areas of the world, explore new sciences, and constantly search for new techniques to perform naval missions. This history of exploration of oceanography, of participation in atomic research, or of reaching into the upper atmosphere to unlock unknown secrets of space led to the development of a tremendous capability in the Navy for scientific explorations. It was very logical, therefore, that as early as 1946 proposals were made for the development of an artificial satellite to be put into orbit about the earth. These proposals were followed in 1955 by the proposals which developed into Project Vanguard as a scientific contribution to the International Geophysical Year. The Vanguard project was subsequently transferred to NASA from the Naval Research Laboratory which had been responsible for its initial development. The benefits from Vanguard to other space programs of the United States in the form of components, techniques, tracking facilities and boosters have been numerous. Although the post-Sputnik

furor confused the understanding of Vanguard's purpose, the project was successful in its contributions to space programs. Similarly, the Navy has provided valuable support to NASA for development of solid boosters, passive communication satellites, and for the NASA weather satellite.

These functions are not competitive to Navy functions, but instead are bonuses that have evolved from the Navy's basic search for better ways to do its job. At present three is not a clear naval use for a man in space, but the Navy willingly supports the civil program toward that goal which is so vital to national prestige. These contributions to the national effort are largely unrecognized by the public because the Navy does not usually publicize what it considers to be the fact of merely doing a job. In the NASA Mercury project for example, the Navy has contributed men, helped to provide the suit they will wear, assisted in monitoring the contract for construction of the capsule, prepared tracking stations, built facilities, provided liaison, provided personnel training, contributed environmental and acceleration research, determined recovery techniques, and provided some personnel for administration of the program. It is not a Navy program, though such a list may give that impression; this type of *support to the national effort* is one of the three ways in which the Navy participates in space activity.

PARTICIPATION IN DEFENSE PROGRAM

The second type of Navy activity in space is its *participation with the other services in military space projects.* This comprises not only supporting research sponsored by the Department of Defense, but includes participation in satellite programs designed to meet military requirements. The Navy's contributions to the military space program have been a direct result of the research and development that was directed toward meeting Naval needs. Navy Bureaus and Laboratories have been working for many years on propellants, engines, rockets, radars, vehicle stabilization, guidance, sensors, atmospheric heating, missile detection, and similar problems. That research which can be used to support space technology is now contributing to, and frequently being supported by, the Department of Defense scientific effort.

NAVAL PURSUITS

The Navy has not, however, ceased looking for new or better ways to do its job, and so the search includes investigation of space techniques. This, then, is the third method of Navy participation in space—*The pursuit of space techniques peculiar to Naval needs.* By analyzing and studying the advantages and threats posed by the advancing technology of space, it can be determined which of these must, or should be, tailored to specific Naval uses. For example, there will be no space-based *weapon* system in the foreseeable future which will effectively accomplish the Navy task of destroying hostile naval elements—the surface, subsurface, and airborne forces. Space techniques for the destruction of land-based threats to Naval forces or to the nation are also very remote possibilities. However, it is very evident that support systems using space techniques may soon augment existing weapon systems or alleviate major command problems. These support systems in the fields of satellite naviational systems, communications, and meteorology comprise the Navy's immediate space goals. In the future, technological developments can make possible the definition of space weapon systems which may revolutionize current concepts of war; in such case, the Navy will develop the future weapon systems needed for the support of Naval missions.

None of the current efforts of the Navy can be classed as "space for space sake" projects but rather are space-oriented systems that offer the best means of obtaining an improvement over present methods. They must compete financially and in efficiency with other systems or their use cannot be justified.

SUPPORTING RESEARCH

These systems which will assist the Navy in accomplishing its task are the eventual results of the basic research that the Navy supports. Between that basic research and the development of systems lies an area of supporting research. Though not identified as systems, supporting research is directed toward improvement of space technology. Areas such as solid propellants, materials, biomedical research, and boosters will certainly yield benefits in many fields in addition to space. They are being pursued vigorously because demands of space techniques require that the greatest advancements possible be made in the stat-of-the art in these areas. Efforts in astro-physics, radio astronomy, investigation of cosmic radiation, and high altitude rocket soundings of the upper atmosphere are being undertaken in order to learn more of the nature of outer space. These are necessary preludes, not only for manned space travel, but also for the more immediate applications of unmanned space vehicles. In addition to research for satellite applications of communications, navigation, and anti-submarine warfare, the Navy is also attempting improvement of satellite payloads to afford greater efficiency, small size, and greater reliability. Supporting research covers a broad area; even such undertakings as improvement of mathematical computers or facilities for data handling are very closely related to the ability to use the information obtained from satellites. Space vehicles must not be considered as the only way to use space, since other phenomena such as ionization in the upper atmosphere or entrapment of free electrons may possibly be used for detection of ballistic missiles or jamming radio transmissions. These are also space applications, and are typical of the diverse areas that supporting research investigates.

FUTURE PLANS

Operational space systems are truly the responsibility of the military services, and in order to use these advanced systems, preparations are now underway. The Navy is preparing to assume the operating costs of the TRANSIT navigation system for the advantages that it will afford. The SPASUR system developed by the Navy under the direction of the Advanced Research Projects Agency must also be improved both in coverage and in speed of data transmission to the fleets in order to minimize any threat from any enemy reconnaissance satellite. Capabilities for surveillance must be improved through use of tactical probes and satellites. The first earth orbiting vehicles capable of yielding worthwhile military information will probably be large, complex, and unfortunately costly. They also will require extensive and complex systems for making available to the user the data they have acquired. The Navy is seeking refinements in payloads and improvements in propellants to afford reduction in satellite size to afford true flexibility in satellite operations. The NASA concept of the SCOUT booster points the way for inexpensive rockets that could be launched from ships at sea anywhere in the world.

One type of launching that could be accomplished at sea is that of launching the super boosters which will be required for space travel. The complex launching platform for such vehicles is not consistent with the Navy's desire for mobility and speed. The technology, however, is one in which the Navy excels. If the nation is to realize the many advantages of sea launch, the Navy is willing to provide to NASA the know-how for launching the super boosters. Their size will necessitate all the familiar techniques of construction movement and support that the Navy has provided for ships.

Beyond these foreseeable applications of space lies a great area of promise which is filled with many unknowns. NASA's exploration of space will yield many answers that are now uncertain. Manned space platforms, lunar bases, and military forces on Mars are subjects for interesting conjecture, but the Navy is not investing large sums in such pursuits at this time. Basic research is essential. Investigation of discoveries is mandatory. Development of systems must be accomplished after these vital steps have justified the further pursuit of a promising technique. This is the underlying theme of the Navy's effort in space. ■

Navy Space Projects

SPASUR

The Department of Defense Space Surveillance System known as SPASUR, was developed by the U. S. Naval Research Laboratory to detect, track and predict the orbits of non-cooperative or hostile satellites passing over the United States.

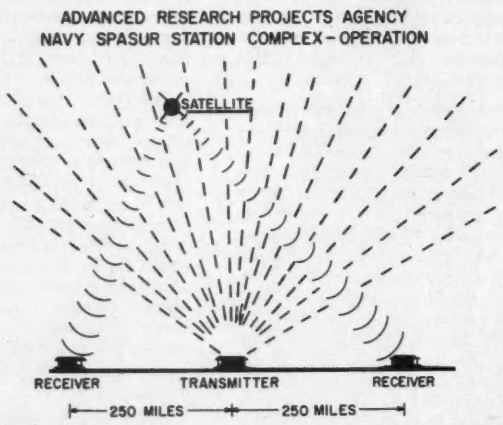
The System consists of three functional subsystems. The first consists of a detection network, the second is a tracking and prediction center equipped with a high speed digital computer, and the third, known as SPASCORE, displays the present, past, or future paths of known satellites in orbit.

The detection and surveillance network consists of two complexes located across the southern part of the United States along a circle line between San Diego, California, and Fort Stewart, Georgia. A third complex is being planned to cover the center part of this fence. Each complex has two 108 mc receiving stations separated by approximately 500 miles, with a 50 kilowatt continuous wave radio transmitter located halfway between the receivers.

COMMUNICATIONS

In addition to SPASUR and TRANSIT, which the Navy is developing for the Defense Department, it is also vitally interested in the area of space communications. The advent of artificial satellites and associated space technology can revolutionize military long distance radio. Communications of the future will be accomplished or supplemented by space relays—active satellite relays (delayed and real time); passive satellite reflectors (natural and artificial); chaff belts, or any material orbiting in space which can serve as a reflector. Advantages which can be expected from the use of space technology for communications include broadening of the usable electro-magnetic spectrum for radio communications over long distances; freedom from the vagaries of sky wave propagation of high frequency radio transmissions; world-wide coverage; less susceptibility to enemy jamming and intercept; and freedom from political implications of base rights. Naval communications over long ranges which might be met by communication satellite relay systems are of several types: fixed point-to-point communications; communications between mobile units; communications between mobile units and shore facilities; and broadcast communications to water-borne units.

The Navy research and development program for communication satellites includes feasibility tests of high altitude satellites as relays between ship and shore stations; extension of the Navy's program of radio communications by moon relay; investigation of systems for polar communication coverage; and concentrated efforts toward communications with submerged submarines.



As a participant in the current DOD communications satellite programs, the Navy has proposed that a ship be instrumented with a complete receiving and transmitting terminal configured for experiments in communications by satellite relay. The experimental shipboard terminal is intended for use with the DOD 24-hour satellite system. Further, it is planned that this installation be flexibile enough to serve as a shipborne terminal for experiments with ship/shore moon relay, passive artificial satellites, or chaff in orbit. The 24-hour satellite system promises to meet many of the long range radio communications requirements of the Navy. Since the development of the special shipboard antenna involves the longest lead time, and must be meshed with the satellite time scale, ARPA has been requested to provide funding assistance initially with Navy RDT&E funding to follow in FY 61. However, it should be noted that a satellite microwave radio relay system does not meet the very important requirement to improve communications to a completely submerged submarine. This is an area wherein the Navy will have to pursue space research toward satisfying a need that is not common to the other services.

WEATHER

The need for improved weather information, on the other hand, is common to the military and civil agencies. The weather satellite requirements of the various departments have recently been consolidated to provide guidance to NASA in the execution of its TIROS project. It is not an easy task to satisfy the many diverse needs of the various customers, even though they are all in favor of better weather information. The Weather Bureau may be looking for long term weather information for scientific study; some military services are seeking leads to better forecasting for land areas; and the Navy is primarily seeking operation weather information in places where no one else is particularly interested. It believes that a weather satellite can help obtain weather information in such areas of the world which are either very remote or which could be devoid of information in wartime. The Navy stresses the importance of rapid availability of the data from such a satellite, because it feels that Naval forces must use weather tactically to maximum advantage.

The Navy is participating in project TIROS, the weather satellite project originally established in the Department of Defense. Since the transfer of this project to NASA, the Navy is continuing its support through the Naval Photographic Interpretation Center which has performed the precision development and photogrammetric analysis of the master photographic record taken by the satellite. Although the TIROS project of two satellites will probably be succeeded by a follow-on program, NIMBUS, the total number of weather satellites will still be relatively few.

PROBES

The Navy has tried another technique for obtaining local weather information by means of rockets which are fired in an almost vertical path above the earth's surface. Project HUGO has demonstrated the feasibility of obtaining photographs over an area of about three million square miles by recovering the payload from such a vertical probe. Rockets of this sort have been used for many years to sample the upper atmosphere, to determine intensity of cosmic radiation, and to conduct numerous scientific experiments. There are further applications of mapping or communications relay which are under study to afford tactical vehicles to perform, at very low cost, some of the tasks envisioned for satellites.

TRANSIT

The Navy currently has two TRANSIT vehicles in orbit. TRANSIT I-B was successfully launched on 13 April and TRANSIT II-A went into orbit on 22 June of this year. A "piggyback" satellite was subsequently released from TRANSIT II-A.

TRANSIT I-B is a 36-inch, 265-lb. satellite carrying two oscillators transmitting back to earth by way of a silver painted spiral band antenna that encircles the satellite. It was launched by a THOR-ABLE-STAR two-stage vehicle from the Atlantic Missile Range at Cape Canaveral.

TRANSIT II-A is a 36-inch, 223-lb satellite, is completely dependent on solar batteries, carries a "piggyback" satellite in addition to transmitters, a Canadian receiver which measures galactic noise and an electronic clock as a time standard. Launching vehicle and launch site were the same as for I-B.

Both I-B and II-A are in near circular orbits of differing inclinations.

PIGGYBACK FROM II-A

Part of II-A's original launch weight was a 40-lb satellite which was carried into orbit and then released to measure solar radiation. The small pickaback satellite, developed by the Naval Research Laboratory, separated from TRANSIT by spring force when orbit was achieved. The piggyback satellite, originally named GREB, is essentially in the same orbit as TRANSIT II-A. Distance between the two satellites is increasing at a rate of 1.5 feet per second.

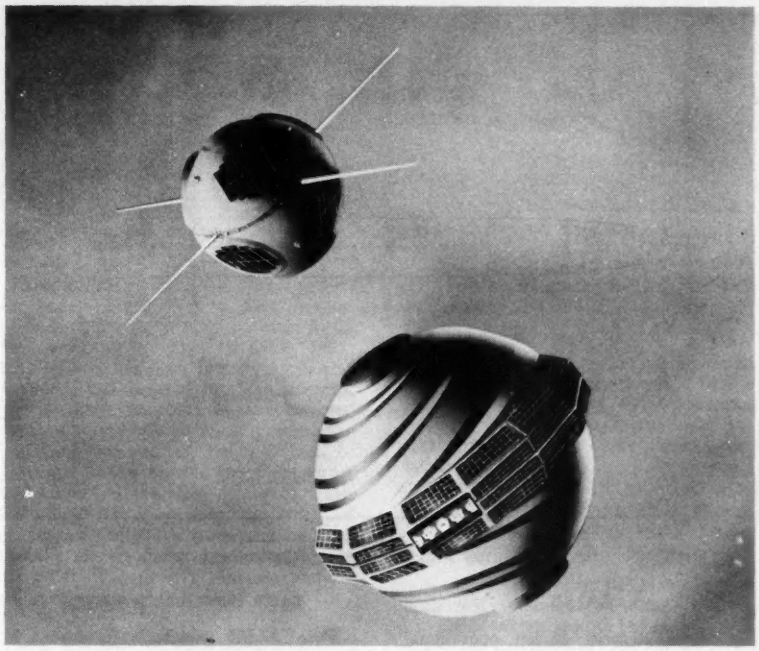
PURPOSE

The TRANSIT satellites are part of the Navy's program to develop an all-weather, global navigational system which would be used by all nations of the world. With the TRANSIT system a reliable means will be available to fix the position of surface craft, submarines, and aircraft anywhere in the world, and in all weather conditions, more precisely than has heretofore been possible, and to provide under any weather condition more accurate means of maritime and aerial navigation than is now available.

TECHNIQUE

As measured from a ground station, the signals from the ultrastable oscillators in a satellite change frequency as the satellite approaches and passes over the ground station. This phenomenom, known as Doppler shift, is the key to the navigational system. By measurement of this shift, the future orbit of the satellite can be predicted perhaps several days ahead. This information, provided through another satellite signal, will permit ships at sea to mark their positions with a high degree of accuracy in any weather.

TRANSIT I-B and TRANSIT II-A transmit on four widely separated frequencies to provide broad experimental control. The change in frequency of the signal is checked automatically by a ground station against a time and frequency standard. This information is then teletyped to a computing center where the satellite's position can be accurately computed. Since the Doppler shift is a direct measure of the rate of change of distance between the transmitter and the receiver at a known location of the ground, future positions of the satellite can be calculated as the satellite's orbit is governed by astronautical laws. Navigation is analogous to tracking and the reverse of the tracking procedure will be used. Since the satellite's positions at future times will be known, Doppler data received by a navigator at one of these future times may be used to determine his position on the surface of the earth.



Drawing of TRANSIT II-A satellite and the Naval Research Laboratory's solar radiation measurement satellite shortly after separation. The NRL satellite was launched into orbit bound to the top of TRANSIT II-A. After orbital injection, the "piggyback" package was released from II-A by spring force and now travels its own orbit as an independent experiment.

SYSTEM WILL HAVE SEVERAL SATELLITES

The experimental navigational system will consist of several satellites and a network of stations at latitudes and positions optimum for accurate tracking. In the operational system, however, a ground station will transmit to the satellite its orbital data for a minimum of one day in the future which will be recorded on magnetic tape. Thereafter, until new orbital data are transmitted, the satellite circles the earth transmitting on two stable, harmonically related frequencies. Thus navigators will need only special receiving equipment to obtain their positions from the satellite. There will be no need to trigger or interrogate the satellite.

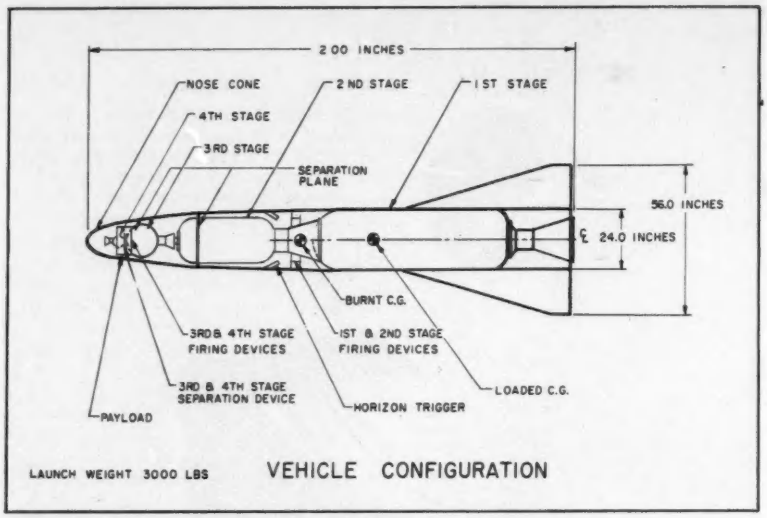
Operational satellites will weigh 50 to 100 pounds, and will be designed to have an operational life of 5 years. They will contain a miniaturized digital memory unit for storing orbital information receiving from the ground station and a modulator for pulse-modulating this information on the transmitted frequencies for retransmittal to the navigating stations. The satellites will be completely transistorized and will use solar power.

DOPPLER BACKGROUND

The TRANSIT navigation system is based upon the ability to extract extremely accurate positional information from the measured Doppler shift of a satellite's transmitter during a single passage of the satellite over a tracking station or ship's receiver.

The Doppler shift is the measurement of the change in frequency of a radio signal continuously transmitted from a satellite. This change, or shift, is caused by the satellite's motion relative to a receiving or tracking station.

This phenomenon was first stated by Christian Doppler, an Austrian physicist in 1842, but its application to precision tracking of an artificial satellite was discovered by two Applied Physics Laboratory scientists, Dr. William H. Guier and Dr. George Weiffenbach only a few years ago. ■



DIMENSIONS AND PARTS OF CALEB VEHICLE

CALEB

A basic element of an operational probe or satellite system is the launching vehicle. For fleet use such a vehicle can be either shipboard or aircraft launched. The Bureau of Naval Weapons is currently developing a vehicle of the latter type. Development work of a low cost exploratory vehicle that can be launched from either the F4D or the F4H fighter aircraft is being performed for BuWeps at the Naval Ordnance Test Station under the code name CALEB. Vehicle development has progressed to the point where instrumented test vehicle firings will be conducted over the Pacific Missile sea ranges in the near future.

CALEB CONFIGURATION

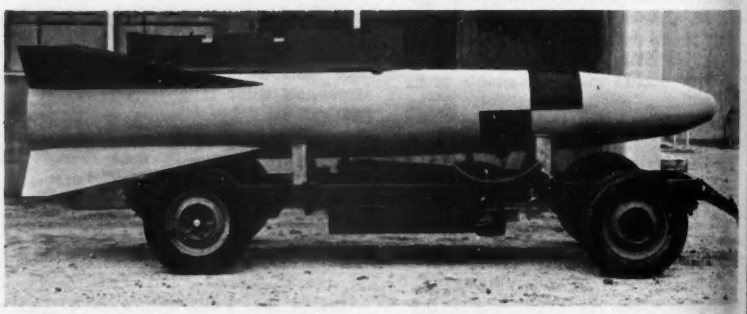
CALEB can be configured as a vertical and horizontal probe with one, two, or three stages of propulsion. With the addition of a retro-mounted fourth stage booster and minor changes in the boster firing system, the vehicle has potential capabilities for launching small payloads into orbit.

SEPARATION FROM F4H OR F4D

The vehicle is suspended by lugs from an Aero 67A bombrack mounted on the fuselage of the F4H or the wing of the F4D aircraft. The vehicle is released from the delivery aircraft at an altitude of 25,000 ft. in a loft maneuver. Release angle is determined by the conventional low altitude bombing system. For vertical probes a release angle of 85 degrees would be used, while for horizontal probes or satellites a release angle of 65 degrees is planned for the initial instrumented vehicle firings. Vehicle separation tests from the F4D aircraft have been successfully performed with dummy vehicles of the type shown on the handling trailer.

CALEB TECHNICAL STATISTICS

The CALEB vehicle is 24 inches in diameter, 200 inches in length, and weighs approximately 3000 lbs at launch. Aerodynamic stability is provided by four delta fins with a span of 56 inches. Initial vehicle configurations will utilize canted fins on the first stage to impart spin for stabilization of later stages. The vehicle stages are attached together by shear pins, which are sheared when thrust is developed by the boosters of each of the stages. The vehicle structure and fins are fabricated from stainless steel sandwich material except for the nose cone which consists of asbestos phenolic material molded on a stainless steel shell. Solid propellant is used in all of the boosters. The boosters are fired in sequence by electronic timers which are initiated by a pull switch when the vehicle is released.



CALEB ON DOLLY AT NOTS

ORBIT TECHNIQUE

The final velocity increment required for orbiting a payload is obtained by firing the retromounted fourth stage booster at the apogee of the transfer ellipse. At this point, the thrust from the fourth stage booster will be in the direction of orbital motion because the spinning fourth stage has maintained spatial orientation during the elliptical path to orbit. The present vehicle design when delivered from the F4H aircraft can develop sufficient energy to orbit 10 pounds in a polar orbit of 1000 miles altitude. In a 30 degree inclined orbit of 300 miles altitude the gross payload weight is 15 pounds.

CALEB PAYLOAD

CALEB vehicle payload summit altitude capabilities as a vertical probe when released from the F4H aircraft at 85 degrees are as follows:

No. of Booster Stages	1	2	3
Gross Payload, lbs.	600	85	13
Payload Volume, cu. in.	20,000	4,000	1,200
Summit Altitude, statute miles	200	1,000	2,000
Time to Summit, seconds	290	660	910
Maximum Velocity, fps	7,800	17,400	24,800

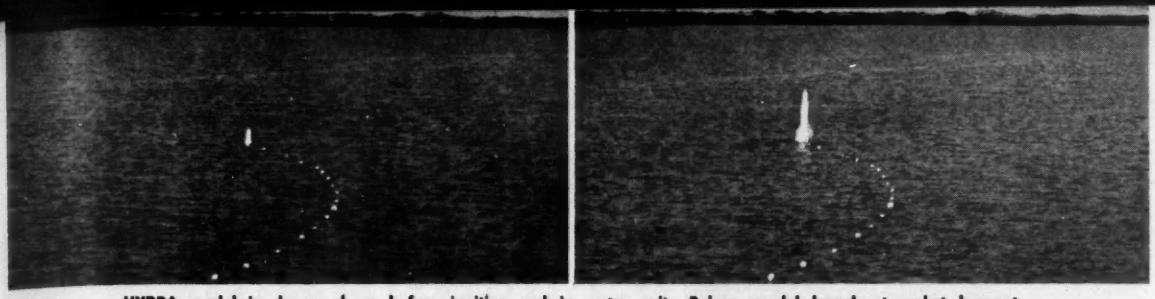
CALEB TRAJECTORIES

As a horizontal probe utilizing the horizon trigger for firing the second stage booster, the vehicle has the capability of achieving the following trajectories when released from the F4H aircraft.

No. of Booster Stages	2	3
Gross Payload, lbs	75	13
Maximum Altitude, statute miles	85	150
Distance to Impact, statute miles	800	13,000
Maximum Velocity, fps	19,000	26,500

The flexibility of the CALEB vehicle in its various configurations combined with the advantages obtainable with aircraft launching provides a versatile space research vehicle for performing scientific experiments.

It is anticipated that the vehicle development program at the Naval Ordnance Test Station will ultimately provide a vehicle of potential operational use to the fleet for reconnaissance, meteorology and other military missions.



HYDRA model is shown above before ignition and in water exit. Below: model launch at rocket burnout.

HYDRA (SEA LAUNCH)

The U. S. Naval Missile Center is testing the feasibility and developing techniques for launching large rockets directly from the ocean. The concept of the spar buoy (vertical-floating) launch is ideally suited for the employment of large solid-propellant rockets. This development program has been named "PROJECT HYDRA (SEA-LAUNCH)" after the many-headed sea monster of Greek mythology.

HYDRA ADVANTAGES

The outstanding advantages for the HYDRA sea-launch technique are:

1. Rocket boosters of any size may be easily transported, erected, and launched with practically no special handling equipment.

2. Mobility is unlimited over the surface of the oceans, and the rockets can also be fired from rivers and lakes of sufficient depth to float the rocket vertically. (Equatorial launch possibilities appear very attractive.)

3. The launch pads are free, water-cooled, and self-healing. This overall economy is one of the strongest advantages.

4. Launch safety is greatly increased, since the rocket is surrounded by water at launch, except for the upper (payload) stage.

5. Range safety and booster fallout problems are almost eliminated by proper choice of launch location.

6. Launch pad availability being unlimited, the scheduled launch rates can be higher than those of a land-based launch complex.

The utilization of large liquid rockets for both scientific and military applications is apparent to anyone who reads the newspapers. The HYDRA SEA-LAUNCH technique for solid rockets, similarly, can be used for both scientific and military purposes in the national interest. Used militarily, it presents an intriguing answer to the problem of moving ICBM's outside the territory of the United States and its allies. For scientific uses, it permits the firing of probes and satellites from any latitude; and the placing of satellites directly into the orbit of desired inclination without an energy-wasting "dog-leg."

NO RADICAL INNOVATIONS NEEDED

At first glance, the HYDRA sea-launch method appears to be so radically different from present launch methods that entirely new and different types of rocket motors would presumably have to be designed, developed, manufactured and tested. The fact is, that almost every large solid propellant rocket now in production can be used without modification or redesign for a HYDRA-launched rocket. These rockets are normally constructed with waterproof closures (seals) in the nozzles. The seals rupture following ignition and the rocket performs perfectly well (even in water) so long as a favorable pressure ratio exists across the nozzle sufficient to establish the supersonic flow.

MISSILE TRANSPORT BY WATER

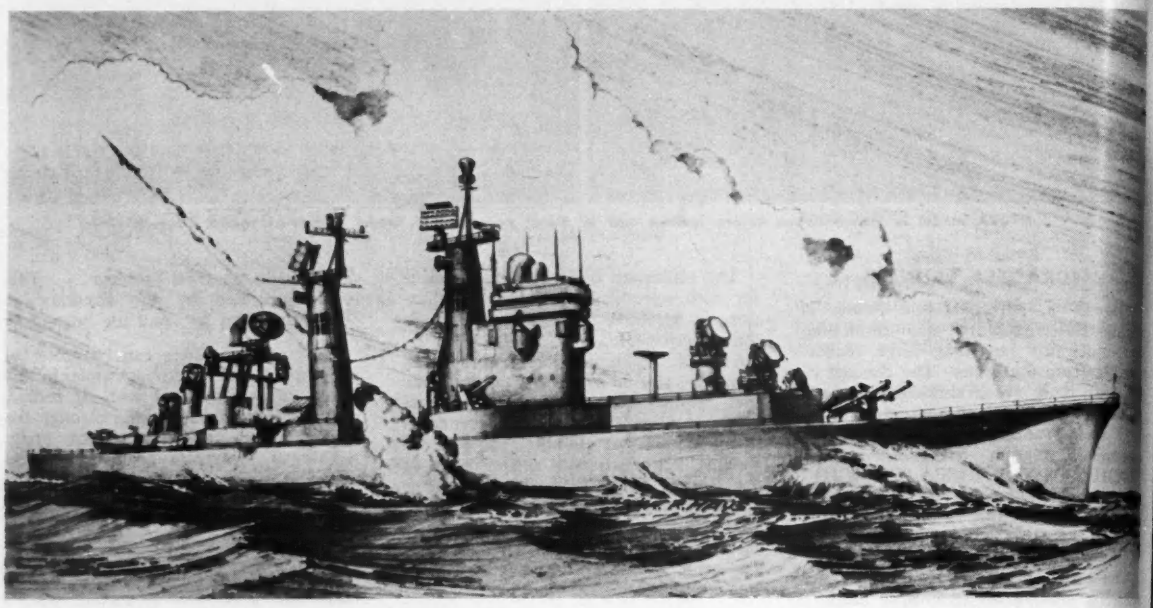
The transport and handling of the large HYDRA-type space boosters would be carried out almost entirely by floating them in the water. Using this philosophy, size presents no great problem . . . This is demonstrated by the handling of 50,000-ton ships by small tug boats.

The rocket boosters can be protected by a number of methods while in the water. The waterproof seal, of course, prevents water from leaking through the nozzle to the solid propellant grain. Additional protection against corrosion and marine growth could be obtained by wrapping or spraying the entire booster with a plastic film which would be removed prior to launch.

At the present time, the Navy has, in mothballs, a number of mobile floating dry docks which would be an excellent means for transporting and checking out water-launched rockets of an extremely large size. They are capable of docking a 2200-ton destroyer, 400 feet in length. A space booster of these dimensions would be able to place an entire manned space station in orbit in one piece.

TEST FIRINGS

A number of test firings have demonstrated the excellent stability of the HYDRA type vehicles. Recently one model was launched in a 59-knot wind with the sea laced with white caps. The HYDRA rocket floated without deviating from the vertical more than 2 or 3 degrees, and then rose vertically into the air when fired. One recent test showed the firing of a 6-ton, 105-foot, telephone pole using a solid rocket. The rocket was ignited 92 feet underwater. The entire assembly rose 380 feet in the air. This is believed to be the longest rocket-boosted shape ever launched in the United States. ■



THE MOBILE LAUNCH CONCEPT is already being developed by the Navy on a smaller scale with the innovation of guided missile launching ships such as the cruiser shown in this sketch. With the true mobile launch concept, however, large sectional floating drydocks with complete launching facilities aboard would make possible the launching of ICBMs, orbital vehicles, and even interplanetary probes from ocean bases, thus taking advantage of earth rotation from any point on the globe because of the advantages of sea mobility.

Mobile Launch Concept

Of special interest to the U. S. Navy is the fact that it is becoming more and more apparent that scientific space programs will soon impose a requirement for launch sites other than the continental United States. This is dictated by program desiderata such as specific launch latitudes and azimuths or potential launch hazards resulting from toxic products of combustion or nuclear contamination.

At the request of the Chief of Naval Operations, the Bureau of Yards and Docks, the Bureau of Ships, and the Bureau of Naval Weapons have completed an engineering analysis of a spectrum of techniques to meet the remote launch capability requirements. The spectrum of techniques investigated ranged from permanent fixed facilities on island X to a mobile sea launch capability.

Based on the results of this study the Commander, Pacific Missile Range was directed to undertake a detailed study to determine the feasibility and desirability of meeting program requirements with a semi-mobile launch complex. The Cal-Val Corporation together with Lockheed has been engaged to assist the Commander, PMR in this task.

SEVERAL AVENUES BEING INVESTIGATED

Several avenues are being investigated to provide mobile launch platforms, including the utilization of large sectional floating drydocks (AFDM), modified reserve fleet ships, stabilized barges and the construction of new devices. It is the further purpose of this study to determine the optimum degree of mobility of the entire complex, including technical support and base support systems. Converted reserve fleet vessels are being considered as potential technical support systems to provide bio-medical laboratories, fuel pressurizing gasses and cyrogenic storage, shop and assembly areas, a communications center, payload laboratories, standard laboratory and special electrical power generation. These vessels could also provide minimum base support under some conditions, consisting of living quarters, hospital facilities, messing facilities, office space, ready issue stores, and fresh water generators. Lift-off and orbital injection instrumentations would be provided by existing and planned PMR instrumentation ships. Guidance state of the art and the need to stabilize the launch platform will probably dictate utilizing some minimum land installation.

SALIENT POINTS IN SEMI-MOBILE LAUNCH

In comparing a permanent fixed remote launch facility with a semi-mobile capability the salient points to consider include:

a. Elimination of a considerable portion of the "overseas construction cost factor." The overseas construction cost factor can range up to 300% of construction in the Continental United States. All of the overseas cost factor cannot be eliminated because certain site preparation will still be necessary and vessel conversions, although accomplished stateside, will be expensive.

b. Minimum base rights agreements for construction of permanent fixed launch facilities will be required.

c. Flexibility to meet varied geographic and program requirements make the semi-mobile concept attractive when compared to a permanent installation.

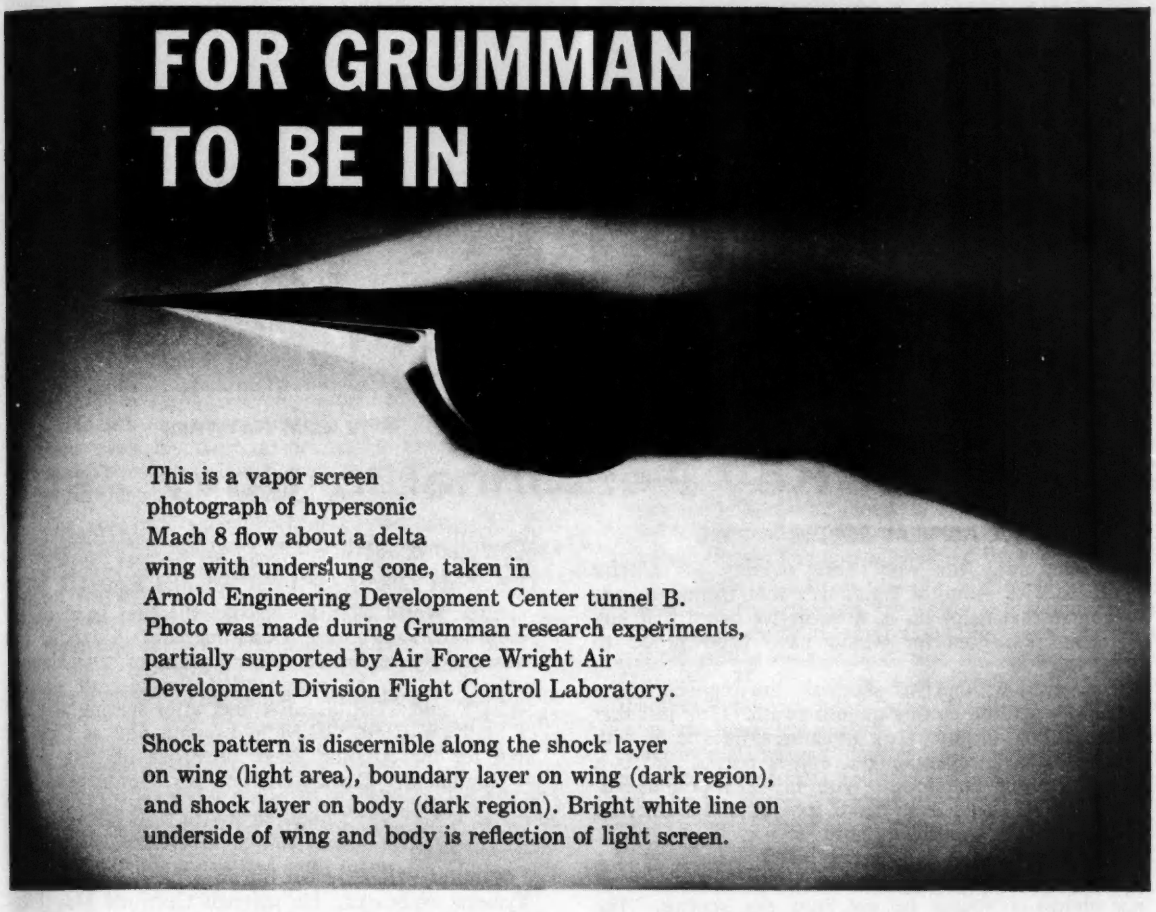
d. Logistic support could include an underway missile system checkout capability to provide vehicles ready for staging.

e. An initial launch capability can be achieved in a shorter time with less expenditure.

SUMMARY

Although the study is not yet complete, indications are such that it is reasonable to believe that remote launch requirements of very large vehicles, which most probably will occur in the near future, can be best accomplished by implementing a semi-mobile launch complex.

NOTHING IS TOO FAR OUT.... FOR GRUMMAN TO BE IN



This is a vapor screen photograph of hypersonic Mach 8 flow about a delta wing with underslung cone, taken in Arnold Engineering Development Center tunnel B. Photo was made during Grumman research experiments, partially supported by Air Force Wright Air Development Division Flight Control Laboratory.

Shock pattern is discernible along the shock layer on wing (light area), boundary layer on wing (dark region), and shock layer on body (dark region). Bright white line on underside of wing and body is reflection of light screen.

This photo characterizes the work Grumman is doing in hypersonic aerodynamics. Other efforts at Grumman include continuing design and development work on orbiting observatories, interplanetary communication systems, re-entry vehicles and reconnaissance satellites, to name a few.

Most important: Grumman has the "people capability" to transform advanced ideas to reality. So . . . if you have a problem that's far out . . . call Grumman in.

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V/ADM PIRIE

V/ADM HAYWARD

Profiles of Key Personnel in Navy Astro

VICE ADMIRAL ROBERT B. PIRIE

Far and away, the Navy's most striking and colorful figure is Vice Admiral Pirie. It's that frontal foliage of course that helps do it, a masterful beard that any Victorian swashbuckler would have been proud to come by.

But, even without his sandyish, graying beard, the admiral would be cutting quite a swath. He's just that outgoing kind of guy. He's gregarious, likes to be with people, is an excellent mixer, enjoys parties and is a connoisseur of fine food. With his 225 pounds admirably distributed over his 6 foot 2 inch frame, he cuts a fine and noticeable figure.

He likes to go duck shooting and is something of a fisherman too, and despite his excellent naval record, it's almost a shame he got into the service. The nation lost another Ben Hogan or Sammy Snead when Robert B. Pirie joined the Navy. Even though his time is pretty much limited these days, he still shoots in the 70's when he gets out on the links.

Admiral Pirie's seagoing career has been almost exclusively in carriers. He's what you might call "an aviator's aviator." The younger men in naval aviation hold the vice admiral in especial esteem . . . the strapping, bearded figure is practically a mythological hero to them.

He flew in fighter squadrons from the LANGLEY and first LEXINGTON, and on his first tour ashore was a flight test pilot. He returned to sea in the first YORKTOWN as executive officer of a scouting squadron.

And, as a matter of fact, he has quite a string of medals for his exploits during World War II. He served as executive officer of the carrier MISSION BAY, and later as Chief of Staff of Carrier Divisions 25 and 4, participating in the assaults on Saipan, Taiwan, Guam, Paulau, and Okinawa, and taking part in the Battle of Leyte Gulf and the Third Fleet China Sea raid. In the final stages of the war he was Air Operations Officer for Fleet Admiral Ernest J. King.

After World War II, he was the first head of the Naval Academy's new Department of Aviation, and subsequently served as Commandant of Midshipmen. Following this, he commanded the aircraft carriers SICILY and CORAL SEA and, after serving as Chief of Staff for CINCNELM in London and as Chief of Staff for the Atlantic Fleet, he broke his flag at sea as Commander Carrier Division Six. Immediately before he assumed his present post as *Deputy Chief of Naval Operations for Air,* he commanded the Navy's Second Fleet.

Admiral PIRIE began life in a landlubberish town, Wymore, Nebraska. He married Gertrude May Freeman of New York City. They have two children, Sandra, who is married to a Marine Reserve Officer, 1st Lt. Jonathan Abel; and Lieutenant Robert B. Pirie, Jr., a submariner.

He likes to keep up with world events and spends much of his reading time keeping abreast of national and international developments. He can more than hold up his conversational end on the subject of communism and its ramifications and machinations.

The Admiral's beard came about quite by necessity. His full name is Robert Burns Pirie and he has the fair complexion of many men of Scot ancestry. So his many days at sea gave him a weatherbeaten skin that made shaving difficult and painful. Doctors told him his facial condition was such that it would be best if he just grew a beard.

At first, the Admiral cultivated his hirsute beauty with some misgiving perhaps, but now accepts it cheerfully. "I can wait to the last minute before taking off for anywhere" he declares, a twinkle in his eyes. "Don't have to shave, you know."

R/ADM MARTELL

R/ADM JAAP

CAPT KIBBE

CAPT BERG

VICE ADMIRAL JOHN T. HAYWARD

John Tucker Hayward is one of those even-tempered but tough-minded guys that seem to work best under pressure, something which in his key job as *DCNO of Naval Scientific Development* he does not lack for. He has an innate scientific sense that constantly amazes even his close associates, a knack of being able to almost instinctively put his finger on the crux of some deep-rooted technical problem.

The admiral's scientific bent comes naturally. His father, Charles, was associated with the Wright brothers and author of outstanding tests on aeronautics. Admiral Hayward has worked closely with Dr. Edward Teller, the "father" of the hydrogen bomb, and is on a first-name relation with some of the other nation's outstanding scientists.

The rugged-looking admiral with the crew-cut could also serve on one of those Viceroy "thinking man" commercials. Away from his Pentagon desk, he could be pictured indulging in that off-beat but exciting sport known as water polo. In his heyday, the admiral was quite a wow at this particular type of sea capering. At the Naval Academy he was a member of intercollegiate champion water polo teams for three years and was an All-American in 1930.

He is still sports minded, although he's pretty much transferred his activity from the blue of the sea to the green pastures of the country club links. He weilds a mean niblick, as a matter of fact, and also goes in, usually not without a modicum of success, for hunting and fishing.

A native of New York City, he attended a private Catholic school, also Oakdale Military Academy, before going to Annapolis. His early duty included assignment to the cruiser RICHMOND, which led to his winning the Silver Life Saving Medal for dramatically rescuing several members of a swimming party off the Honduras.

Two years after leaving the Academy he became a naval aviator, has since had more than 12,000 hours of flight as a pilot and has played an important part in the Navy's development of new aircraft. He was the first Naval aviator to land heavy attack aircraft on board our carriers and had the job of welding the atom to the fleet, having a tour of duty with the Atomic Energy Commission. He was military Director of Plans and Operations at the Los Almos Scientific Laboratory for awhile, stressing the application of atomic weapons into military matters. But no landlubber, by any manner of means, he had command of the giant carrier FRANKLIN D. ROOSEVELT before coming to the Pentagon.

He has an outstanding war record, commanding a bombing squadron in the Pacific and was awarded the Silver Star Medal, Legion of Merit and the Distinguished Flying Cross (four times) and the Air Medal (five times). He also wears the Purple Heart—for wounds received during a bombing by enemy aircraft.

The admiral, married to Leila Marion Hyer of Pensacola, has five children, four girls and a boy. If you have any scientific leanings at all, you won't have any trouble getting on a subject that will interest Admiral Hayward. He has made a study of such things as theoretical physics, electronics, V. H. frequency currents, mathematical analysis, elementary foundry works, experimental atomic physics, applied gyrodynamics, magnetism, exterior ballistics of rockets, propellant chemistry, optics, explosing casting, atmospherics physics, wave mechanics, plutonium processes, compressible and supersonic flows.

Just to mention a few things.

REAR ADMIRAL CHARLES B. MARTELL

As the individual personally charged with the responsibility of the *management of the organization charged with CNO's research and development efforts responsibilities,* Rear Admiral Martell has a lot of problems to wrestle with. But he's always displayed a facility for this sort of thing. He was on the Naval Academy's varsity wrestling squad.

But there was brain here as well as brawn. He finished 15th in a class of 405. After the usual assignments at sea, Admiral Martell began his role in the Navy's scientific end of things by returning to Annapolis to study ordnance engineering. He continued this course at Carnegie Tech, receiving there a degree of Master of Science in metallurgy. During World War II he played a vital part in the formulation of policies, means and methods for the procurement of needed equipment for the fleet, winning the Legion of Merit for his efforts.

His sea experience has not been exactly neglected though. In the early '50s he served as Fleet Operations Officer for the U. S. Pacific Fleet and he was the commanding officer of the battleship MISSISSIPPI, when it introduced the TERRIER missile, a dramatic moment that introduced a new era of weaponry into fleet operations. And he was the CO of the BOSTON after it became transformed into the first guided missile cruiser.

Practically a Bostonian . . . he was born in Dorchester, Mass. . . . he is married to Mary Elizabeth Adams of Ann Arbor, Mich., and has two married daughters, Mrs. Ritchie Lynn Perna and Mrs. Sally Toot Ward. The family wouldn't be quite complete though without mentioning Tami and Gina, a couple of poodles.

Admiral Martell usually takes them wherever he goes, which can be half way around the world. He's so fond of them that he gives them their trim clippings himself. He's become so good at it that there's no doubt that he could become a professional poodle barber if he ever took the notion.

The admiral is what is known as a "good Joe" in the Navy and probably has written as many personal-type letters as anybody in the sea-going service. Some yeoman or boatswain's mate who served under him two hitches back may drop in on him for some help in some matter and, as likely as not, the admiral will be getting off some kind of helpful letter on the sailor's behalf. Or, he may simply get off some short personal letter thanking somebody for some routine consideration or favor, which many people would never bother to acknowledge.

The B. in the admiral's name stands for Bowling but he prefers fishing as a recreation and is also partial to seafood, technical publications and the N. Y. Times.

REAR ADMIRAL JOSEPH ABRAHAM JAAP

Joseph A. Jaap is one of the Navy's quiet, soft-spoken men. Inclined to be somewhat on the self-effacing side, he nevertheless holds down one of the Navy's top jobs. As *Director of Development Programs*, he is responsible for the monitoring and coordinating of the Navy's research, development, test and evaluation programs . . . and, in addition, he is Executive Member of the Navy's Ballistic Missiles Committee, which is responsible for the direction of the Fleet Ballistic Missile program.

Two World II citations give insight to the hard core of this man who, in mufti, at first glance, might pass for the neighborhood grocer:

"When he was informed during a patrol flight that several men were adrift in the heavy sea, he decided to attempt an open sea rescue despite the hazards involved. Skillfully effecting a landing and take-off . . . he succeeded in rescuing nine survivors of the torpedoed tanker who had been adrift for 12 days. His bold initiative as well as his skilled airmanship were contributing factors in saving the lives of these men . . ."

"Demonstrating outstanding ability, Commander Jaap (then in charge of U. S. Naval Forces in the Azores) skillfully handled a delicate situation and obtained the complete cooperation of all Allied Forces in the area, thereby contributing materially to the successful employment of the Fleet in the Atlantic . . ."

After the war, the admiral had a varied assortment of duty that included not only taking command of two carriers, the BADOENG STRAIT and CORAL SEA, but serving as head of the Air Applications Branch, Atomic Energy Division, Naval Operations; director of the armament division Bureau of Aeronautics; Navy member of the Military Liaison Committee to the Atomic Energy Commission; Chief of Staff and Aide to Commander Carrier Division SIX.

Admiral Jaap is a native of Denver and married Frances Marian Davies of Seattle, Wash. They have two children, Ensign Joseph Davies Jaap and Anne Marie, who is attending Newton (Mass.) College.

He is an easy man to talk to . . . there is something quite folksy about him. He is a rare combination of being both a gardener and something of a golf bug. He announces proudly that after being at it for 35 years he has finally managed to slice a dozen strokes off his game.

He has an adventure for food, enjoys trying the exotic and off-beat fare in out of the way places. Something of a chef himself, he likes to concoct all sorts of marinated items.

One of his favorite forms of relaxation though is watching the wrestling matches on TV. "I know they're phoney," he says, "so I can just lean back in my chair and take it easy."

CAPTAIN RICHARD L. KIBBE

You'd have to say that temperamentally Capt. Richard L. Kibbe (pronounced Kib-bee) is just the guy to hold the post he does, *Director of the Astronautics Operations Division in the office of the Chief of Naval Operations*.

He dotes on reading the classic Navy adventure stories, from Nordoff & Hall to Forester.

And, while it is something that probably never would occur to the captain while he is absorbed in these tales of derring-do, he is something of a prototype of such stories himself.

As commanding officer of Bombing Squadron Thirteen, he participated in some of the hottest action of World War II in the Pacific, from the Mariannas to the Philippine campaigns. In a single mission he took part in the sinking of four Japenese aircraft carriers. He was awarded the Distinguished Flying Cross, the Navy Cross and three Air Medals . . . and he wears the Purple Heart for wounds received.

After the war, Capt. Kibbe's Navy assignments included serving as Operations Officer of Carrier Division One, Executive Officer of the carrier CORAL SEA, assistant director of research and development with the Bureau of Ordnance, commanding officer of the carrier FORRESTAL and deputy chief of legislative affairs in the Office of the Secretary of the Navy.

Capt. Kibbe is a native of Sullivan, Ill. His dad, who had the off-beat given name of Mirro, was a

Florida real estate operator. Capt. Kibbe's wife's name is Mary Grace, she's from Boston and they have a son, Richard, Jr., who is a midshipman at the Naval Academy, and a daughter, Barbara, who is married.

The L. in Capt. Kibbe's name is for Lucius, but he doesn't look like the type of fellow who would have encouraged much smirking over said fact. He uses the term "Buck Rogerish" in refering to some futuristic scientific thoughts and notions but you get the idea that he does not do so scornfully at all but is a great believer in the marvels to come.

He gets out on the golf course once in awhile and likes to fish too when he gets the time. He is partial to Southern fried cooking and, he says, "alas, to almost anything fattening."

CAPTAIN WINFRED EMIL BERG

The saga of Winfred Emil Berg is that he grew up on a Texas ranch, went to sea and then became a proud and confirmed suburbanite.

Of course, there is a little more to it than just this. He is, for instance, *Director of Astronautics, Development Division, Office of the Chief of Naval Operations,* which is not only quite a mouthful, but quite an important job in the Navy's air space scheme of things.

Capt. Berg, who was born in Fredericksburg, Tex., attended Texas A. & M. before entering the Naval Academy. At the outset of World War II, he served on the cruiser INDIANAPOLIS, then became a naval aviator and wound up as executive officer of a bombing squadron and, later, was with an Air Transport Evacuation Squadron, which won a unit citation for heroic actions.

He was plane commander of an air transport squadron for awhile too, then went to the U. S. Naval School and Massachusetts Institute of Technology to study electronics engineering. For awhile he was attached to the Naval Research Laboratory as Program and War Plans officer, then was with the Naval Air Test Center and later became Senior Program Officer for the Navy's historic and successful Project Vanguard, which was this nation's first satellite program.

The captain, who has never lost his Texas drawl through all of this, is married to Charlotte Noyes, a Yankee gal, formerly of Haverhill, Mass., and there are four Berg children, a boy and three girls. The boy, Ericson, oldest of the children, attends Texas A. & M.

Capt. Berg takes his community responsibilities seriously. Lately he has had to taper some of this communal activities down because his astronautics post has become so time-absorbing, but, for instance, he's president of a community swimming pool in his residential section of Alexandria, Va., even though he isn't much of a swimmer himself and doesn't have too much of an opportunity to get over to the pool anyway.

Capt. Berg is a Hi Fi fan, enjoys listening to good music and also likes to putter around the lawn and garden.

"I just enjoy being a suburbanite," he admits quite frankly."

R/ADM CONNOLLY R/ADM RUCKNER

REAR ADMIRAL THOMAS F. CONNOLLY

It is a well-known fact that the tennis racquets of most men in their 50s lie a-moldering in the attic. But Thomas Francis Connolly's racquet strings go awry for another reason. From the constant banging of the strings against balls.

At 50, the admiral still gives a good account of himself on the tennis courts. A keen-eyed, intense man, he is also quite a whiz on the golf course, often shooting in the low 70's despite the fact that he's strictly a week-end linksman and lucky now when he can get away then from his post as the *Bureau of Naval Weapon's chief for the Pacific Missile Range and Astronautics.*

The admiral is still an "aviation bug" too, as enthusiastic about flying as any young fellow first getting acquainted with the clouds. He not only likes to fly to wherever duty may call but still gets a thrill whenever circumstances permit him to be at the controls.

He's quite a bug about languages too. As a midshipman at the Naval Academy, he was awarded the Society of the Cincinnati Sword for excellence in modern languages. And the Academy probably never had a more knowledgable athletic editor for its publication, "Lucky Bag," than Tom Connolly, for he was quite an athlete in his own right, being on the Academy's track team and on the 1932 American Olympic team as a gymnast, specializing in rope climbing.

The admiral was born in St. Paul and attended the University of California before his Academy appointment. During World War II, he distinguished himself while in command of a patrol squadron. A typical citation of his reads: ". . . Commander Connolly led his unit through intense antiaircraft fire in pressing home a bold strafing and bombing strike at masthead height against the strongly fortified Japanese base . . ."

Incidentally, the admiral is not only a conventional pilot but when he was director of the Navy's test pilot training after the war, qualified as helicopter pilot also. His post-war duties also have included the commands of the carriers CORREGIDOR and HORNET and Experiment Officer at the Naval Ordnance Test Station, Inyokern, Calif.

CAPT FAHY

CAPT HELFRICH

Admiral Connolly is married to Margaret Irene Hagy of Beverly Hills, Calif., maintains a residence in Holland, Mich., but currently is making his home in Arlington, Va. The Connollys have two children,, Tom Jr. and Susan.

Despite his interest in athletics both as a participant and spectator . . . he's an avid Yankee fan . . . the admiral finds time to do considerable reading. Something of an author himself, he once wrote a definitive book on the dynamics of flight, he is intense even about his own reading matter. If he runs across an article that he thinks might be of interest to his staff, might broaden their horizons or give them a new slant on things, he is sure to bring it to his office and enthusiastically pass it around.

REAR ADMIRAL EDWARD ABERLE RUCKNER

No question about Admiral Edward A. Ruckner being a rugged individualist.

He has persistently held out against acquiring a TV set.

In his leisure moments, he likes to go to such media as Fortune, National Geographic Magazine and such well-established and respected publications.

But while Admiral Ruckner, *the Assistant Chief in the Bureau of Naval Weapons for research, development, testing and evaluation,* may have some deeply conservative instincts, there's no doubt that he has given considerable thought to, and is eminently qualified to consider, futuristic matters, particularly as relating to sea power.

He has been particularly interested in gunnery and fire power almost since the inception of his naval career. He was a gunnery officer on such ships as the WORDEN, DEWEY and BRAZOS. He studied ordnance engineering and fire power and control not only in postgraduate Naval Academy work but also attended the Massachusetts Institute of Technology, receiving a degree of Master of Science. He then served as a fire control expert with the Navy's Bureau of Ordnance and at the outset of World War II has the important task of procuring firing mechanisms and radar equipment.

During the war, he served as gunnery officer aboard the MEMPHIS and also became operations and gunnery officer of Cruiser Division TWO. He assisted in fitting out the new cruiser ATLANTA and served aboard it as her first gunnery officer and later as executive officer.

After the war, he was a member of the Ship Characteristics Board, served as commanding officer of the destroyer GREENE and also the battleship MISSISSIPPI and was ordnance officer for three years at the Naval Proving Ground in Dahlgren, Va. This past July he was advanced to the rank of rear admiral.

Admiral Ruckner is a New Jerseyite, having first seen the light of day in Jersey City. He attended Rutgers University before entering the U. S. Naval Academy. He married Rosa Roszel McGill of Baltimore and they have two children, Ed Jr. and Rosa.

There are two things that Admiral Ruckner likes to do besides not watching television. He enjoys working around in the garden and he likes to go bird hunting too.

CAPTAIN EDWARD JOSEPH FAHY

Ed Fahy, son of a Manhattan building contractor, wanted to go to the Naval Academy. Still, upon leaving high school he didn't go straight to Annapolis but worked for awhile with a 'phone company and an insurance corporation. There was a method to this marking time, for, somewhat on the short side, he wanted to build himself up physically as a likely possibility for the Academy football team.

In 1929 he joined the Naval Reserve and competed for and won an appointment to the Naval Academy. While never able to muster enough avoirdupois to make himself formidable enough for the gridiron, he did make both track and gym teams. In fact, he was an outstanding cross country runner and captained the Academy's cross country team.

Something else Ed Fahy did was graduate with distinction from the Academy in 1934, serving as Regimental Commander during his senior year.

After he left Annapolis, the New Yorker, now Captain Edward J. Fahy (pronounced "Fay"), Assistant Chief of the Bureau of Ships for Research & Development, saw duty not only aboard a cruiser but became a submariner too. During World War II, he served both aboard the subs SPEARFISH and PLUNGER, becoming skipper of the latter. In the final year of the war, he served with the Pacific Fleet command as Tactical Officer, then as New Developments and Electronics Officer.

Before taking over his present important post, Capt. Fahy had duty at both the Norfolk and Mare Island Naval Shipyards and he also served as director of the Navy's Underwater Sound Laboratory at New London, Conn.

He's married and has four daughters—Libby, Toni, Cathy and Bridget—and his youngest, Eddie, Jr., a 12-year-old. Mrs. Fahy, also a Manhattanite, is the former Cecelia Finn, whom most everybody just calls "Ceal".

After all these years though, Capt. Fahy still hasn't been able to get into the football weight class. He's as lean and wiry as ever. So he's settled for things by sailing and getting out on the golf course.

CAPTAIN HARRY DANIEL HELFRICH, JR.

Capt. Helfrich takes a rather wry view of modern day living. After expending some $3000 to modernize the kitchen of his home, doing much of the wiring himself in transforming it into an all electric affair, his wife insists, the captain reveals, that much of the meat be charcoal broiled in a "primitive brick pit." "That's suburbia for you," he sighs resignedly.

Capt. Helfrich comes from Hagerstown, Md. His dad was a railroad man. After graduating high school, Capt. Helfrich spent about a year and a half in that old depression-time outfit, the Civilian Conservation Corps (CCC). When his chance to take the Annapolis entrance exam came, he went home and spent something like six months preparing himself for his big break.

He was engineering division officer on the battleship TENNESSEE for awhile, saw service aboard the sub-hunting destroyer DICKERSON during the outbreak of World War II. He became a naval aviator during the war and wound up on anti-submarine patrol in the Caribbean.

He returned to Annapolis to take an electronic course and for some 13 years now has been closely associated with the electronics end of the Navy. He was project coordinator of the electronics test division at the Patuxent River, Md., Naval Air Test Center for three years.

His present slot, which he took over just this summer, is *Astronautics Programs Officer for BuWeps.*

Capt. Helfrich married Diana Hope Greene of Kennebunk, Me., and they have three children, Hope, David and Michael, agers 15 to 6. The captain calls Fogg Point, Me., a salty address if ever there was one, as his official residence but is presently making his home at Arlington, Va.

CAPTAIN ROBERT F. FREITAG

Friends of Captain Robert F. Freitag, *BuWeps Astronautics Officer,* say he's been in the missile and rocket field so long that he's beginning to act like one.

It is a fact that Bob Freitag has been continuously assigned to billets in the missile and rocket field for a decade and a half now. It is also a fact that probably no one else has been on the go so much to speak out for the Navy's role in space as has this young captain. Few weeks go by that he hasn't spoken before some group or other, whether it's a Navy-oriented or rocket-minded group or just some plain civic gathering, and he has plenty to say about the Navy in the space age.

He conscientiously writes all his own speeches. He is, in fact, something of a writer, to boot. His articles keep popping up in this publication and that. He has one coming up in the Naval Institute Proceedings soon on why it's essential that the Navy get into space.

Captain Freitag, who has just nudged into the 40's, was born in Jackson, Mich., and is a graduate of the University of Michigan (B. S. E., Aeronautical Engineering). He also did graduate work at the Massachusetts Institute of Technology.

At the close of World War II, he was in on the guided missile information that was obtained from the

CAPT FREITAG

LCDR EDELSON

defeated Germans and, in one way or another, he has had something to do with rocketry on behalf of the Navy ever since.

The captain is married to Maxine Pryer of Nunica, Mich., and they have two daughters, Nancy Marie, who is attending Western Michigan University, Janet Louise who goes to high school and a son, Fred, age 4, "who is all over and everywhere."

There are some in the Navy who are convinced that if Bob Freitag isn't actually the first man to make it to the moon he'll be the first one up there to make a speech anyway.

LIEUTENANT COMMANDER BURTON IRVING EDELSON

For quite a young fellow, Lt. Commander Edelson certainly has himself a title—*Head of the Astronaut Branch, Warfare Systems, Research & Development, Division of the Bureau of Ships.*

The job seems to be in good hands though. Commander Edelson is not only a graduate of the Naval Academy but of Yale. He went to Yale after four years at sea, in which he served aboard the destroyers COLLETT and WANTUCK and the minesweeper SWALLOW, and earned a Master of Science Degree in metallurgy. He also recently got a Ph. D. degree from Yale after working on his thesis in his "spare hours" for something like five years.

Commander Edelson comes from East Lansing, Mich., where his dad was a clothing merchant. When young Burt decided to go into the Navy, the music world lost a promising performer. He's quite a whiz with the clarinet. When he was stationed with the Navy in Cleveland as a planning and development officer, he played with a symphony orchestra.

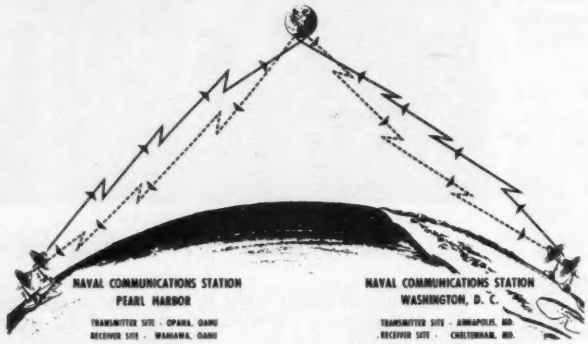
He also goes in for some backyard chefing, doesn't mind getting involved in a bridge game once in awhile and likes to do some puttering around the house once in awhile. He's been so busy for so long working on his Ph.D. thesis that he says he's just now beginning to "get his breath again."

There's no question about his marriage being a *Good* match. That's who he married, Betty Good of Baltimore.

They have two young sons, Stephen, 5, and John, 2, and he says they form his main source of exercise these days. ■

Naval Activities Engaged in Astro R&D

COMMUNICATION MOON RELAY SYSTEM



THE NAVAL RESEARCH LAB IN THE SPACE AGE

Progress in the space age—extending man's knowledge of the world around him and defending him against totalitarianism—is one of the major goals of the U. S. Naval Research Laboratory, Anacostia, Washington, D. C.

Since its inception in 1923, NRL has grown into one of the foremost scientific research establishments in the world. Its 4 buildings, fewer than 100 employees and two scientific divisions have matured into 106 buildings, more than 3200 persons and 13 divisions. In addition to its 59 acres on the Potomac River in Washington, D. C., the Laboratory directs the operations of the Chesapeake Bay Annex, the Maryland Point Observatory and two facilities in the Panama Canal Zone. The six stations in the Navy Space Surveillance (SPASUR) system, as well as several specially equipped planes and ships, also fall under the scope of the NRL research program.

NRL STARTED WITH RADAR

NRL's first clearly defined step into the space age was taken in the development of radar. The principles of radar were discovered by Dr. A. Hoyt Taylor and Leo C. Young of the Naval Aircraft Radio Laboratory (a forerunner of NRL) in 1922. They continued their research on radar at the Laboratory. Between 1930 and 1936, with the original experimentation augmented by such men as L. A. Hyland and Robert M. Page (now NRL Director of Research), radar came into its own. Between 1937 and 1939 NRL radar was successfully tested at sea.

World War II proved the worth of radar to the Allied cause. In the Pacific, the Japanese attributed many of America's naval victories to radar, while in the Atlantic, the Nazi U-Boat high command blamed its failures on Allied anti-submarine devices.

Today, radar plays an increasingly important role in the fields of both peacetime scientific research and "cold war" preparedness.

NRL SPACE COMMUNICATIONS AND SURVEILLANCE

In the field of communications satellites, NRL has done considerable research in utilizing the moon as a passive reflector of signals. This reflection technique, called the Communication Moon Relay system and proved feasible by NRL in 1951, was demonstrated in January 1960 by the Navy with the relay of a message between Washington, D. C., and Hawaii.

Another key contribution of NRL to the space age is the Space Surveillance (SPASUR) system developed under the direction of the Advanced Research Projects Agency. Stretching from Georgia to California, SPASUR creates an electronic barrier extending hundreds of miles into space. Satellites passing through this barrier are "illuminated," causing a signal reflection to one or more of the four listening stations.

NRL ATOMIC PROJECTS

Even before World War II, the Laboratory was working on thermonuclear energy, particularly in the realm of propulsion. It was an NRL report, complete with blueprints, that laid the groundwork for the U. S. Navy's atomic submarines. At present, NRL is conducting a nuclear physics program with a pool-type reactor and several smaller nuclear research facilities.

NRL ROCKET RESEARCH

The Navy's role in astronautics may be said to have started on December 17, 1945, with the establishment of the Rocket-Sonde Research Branch of NRL to "investigate the physical phenomena in, and the properties of the upper atmosphere." Exhausting a supply of war surplus German V-2 missiles, NRL launched the first all-U. S.-built research rocket—VIKING I—from White Sands, New Mexico.

With these Viking rockets and other space vehicles, such as the AEROBEE-HI, fired over 100 miles into the upper air, Laboratory scientists obtained high-altitude photographs of the earth and measured solar and celestial radiation in the atmosphere.

NRL rockets—fired from the ground, from the decks of ships and even from balloons—were instrumental in exploring the earth's atmosphere, studying a solar eclipse and obtaining the first Lyman-Alpha and X-ray photographs of the sun.

The most "sophisticated" naval rocket was the VANGUARD, which was successfully launched on March 17, 1958. The NRL-developed satellite placed into orbit by that rocket is still gathering information on air density, temperature ranges and micrometeorite impact. Because of VANGUARD I's stable orbit, islands in the Pacific have been relocated properly on the map and the shape of the earth found to be somewhat different than previously believed.

Although the VANGUARD project and its personnel were subsequently transferred to the National Aeronautics and Space Agency, NRL continues to participate actively in the space satellite program.

On June 22, 1960, a rocket fired from Cape Canaveral placed into orbit a 20 inch solar radiation satellite designed and built by the Laboratory. Launched as a "piggy-back" rider of the TRANSIT IIA navigation satellite and separated from it after reaching desired altitude, the NRL globe constitutes the first above-atmosphere, long-term study of solar emissions.

NRL RADIO ASTRONOMY, METALLURGY AND HUMAN ENGINEERING

Under the radio astronomy program, which NRL entered in 1946, Laboratory scientists are studying the radio emissions from the universe. The studies are conducted with radio telescopes ranging from 10 to 84 feet in diameter. In the future the program will be augmented by the world's largest moveable structure, a 600-foot radio telescope at the Naval Radio Research Station at Sugar Grove, West Virginia.

Major contributions in metallurgy, vital in an age of high speeds and altitudes, have resulted in advances in making metals immune to the adverse affects of extreme temperatures.

Another problem, begun in the mid-1940's, involves better fitting the Navy machinery to the Navy man. Engineering psychology, or "human engineering," has greatly increased in importance to the Navy in an age of complex machinery.

NAVAL ORDNANCE TEST STATION ASTRONAUTIC CAPABILITIES

The Naval Ordnance Test Station at China Lake, California, has capabilities in astronautic research from two sources: first, the total facilities of a large research and development organization; and second, those specific, unique installations that have a special significance in the field of astronautic research.

PROPULSION RESEARCH

NOTS' range of experience in the field of rocket propulsion includes work on solid-propellant vehicles (ASROC, POLARIS), liquid-propellant vehicles, and hybrid propulsion systems. Particularly significant capabilities exist in the form of large solid- and liquid-propellant test stands (Skytop I and II), the HARP high-altitude pyrotechnic test chamber, and the broad range of research in liquid propellants.

Skytop I and II

Both of the Skytop test stands are capable of testing solid-propellant rocket motors of up to a million pounds thrust. Both test stands are highly instrumented. Both stands handle the thrust of large solid-propellant motors by using a backstop and a horizontally-mounted motor.

Skytop I and II both use the same data-collection and reduction facilities.

Here the similarities end.

Skytop I is the older and less flexible of the stands. It can be used for tests of solid-propellant motors only in the horizontal position, in any thrust range up to 1,000,000 lbs. A movable shelter on tracks and an overhead hoist facilitate work on motors.

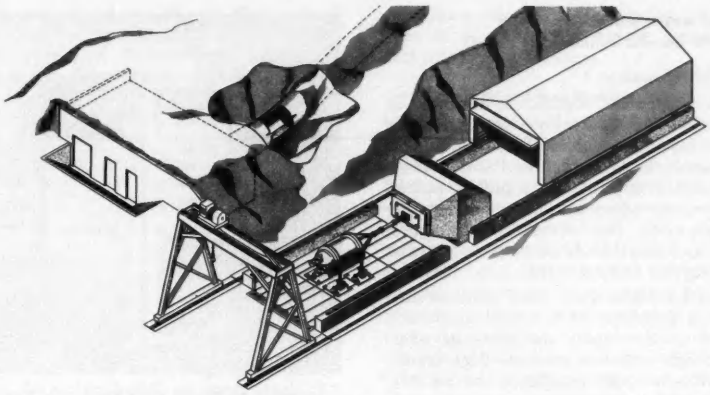
Skytop II is both far simpler in appearance and far more flexible than Skytop I. Essentially, Skytop II is a small artificial mesa bulldozed out of the desert. On top of the mesa is a huge steel wedge, the backstop. There is a notch in the earth at one end of the mesa, surmounted by a "conventional" test-stand framework.

The framework can handle vertically mounted rocket motors, both liquid and solid fuel, of up to 250,000-lbs thrust. The simple steel backstop is capable of withstanding thrusts of 1,000,000-lbs. All of the usual test-stand instrumentation lines are buried under the surface of the mesa, as is the cable room. A mobile crane is used to handle heavy equipment and the motors. Million-pound rocket motors can be tested to destruction without ruining the stand.

The ability to destruction-test large motors is very useful: the behavior of motors with cracked propellant grains or ruptured chambers can be tested. Formerly, these motors, which can yield valuable data, could not be tested without endangering the work schedule of the stand, since a major explosion might severely cripple Skytop I. The open, unobstructed surface and underground instrumentation of Skytop II, on the other hand, is relatively safe from damage and is easily repaired.

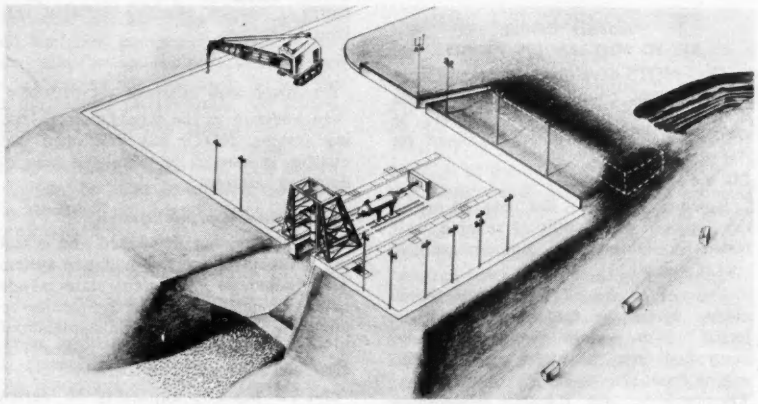
A recently installed data-reduction facility at Skytop is a direct digital readout console that makes available quantitative data as well as the more usual graphic data immediately after the test. The new console uses a ferrite-core storage system similar to that used in large electronic computers. This memory system permits rapid accumulation of, and immediate access to, the data.

The Skytop test facilities combine important innovations in test-stand design and instrumentation to constitute a potent capability for propulsion research.



SKYTOP I TEST BAY

Shown is large POLARIS-type solid-propellant rocket motor on test stand. Work shelter is rolled away, ready for test run. Underground cable tunnel runs from buried patch-panel room to data recording center. Skytop I can be used for testing solid-propellant rocket motors of up to 1,000,000-lbs.



SKYTOP II TEST BAY

Framework, deflector pad at the right can be used to test solid, liquid rocket motors of up-to-250,000-lbs. thrust. 1,000,000-lb. solid-propellant rocket motors, including defective motors likely to explode, can be tested horizontally against the steel backstop. Instrumentation wires are armored, buried in artificial "mesa," are safe from damage if motor explodes. Tread-mounted mobile crane is used to handle motors, other heavy equipment.

HARP High-Altitude Test Chamber

The HARP chamber is 35 feet in length and 16 feet in diameter, and has a volume of about 7,000 cubic feet. A 40-horsepower pump can evacuate the chamber in half an hour to a pressure equivalent to an altitude of 100,000 feet. Simulated altitudes of 200,000 feet are attainable over a longer time.

Propellants and other combustible items can be tested under close control for their performance in near-space conditions. Instrumentation exists for measuring infrared radiation, visible light, pressure, thrust, temperature and timing of events. The chamber can test small liquid- and solid-propellant motors. A 100-g centrifuge has been installed for testing acceleration effects on pyrotechnic devices at high altitudes.

Liquid Propellants

A number of significant advances in liquid-propellant rocketry originated or have been tested at NOTS. Among these advances have been the Packrat four-barreled, single-chamber liquid-propellant motor, secondary injection for deflecting thrust, and the demand-thrust rocket motor, a variable-thrust motor which can be stopped and restarted.

NOTS researchers have also worked on the problems of a hybrid propulsion system, solid/liquid combinations offering high specific impulse, high-density loading, and safe handling—and on free-radical fuels.

The range of investigation assures NOTS of a continuing capability in the newest areas of rocket propulsion.

VARIABLE THRUST: KEY TO SOFT-LANDING PROBES

The NOTS-developed demand-thrust rocket motor, coupled with a proposed optical sensor, may be the solution to soft-landing an instrument package on the moon.

The Variable-Thrust Motor

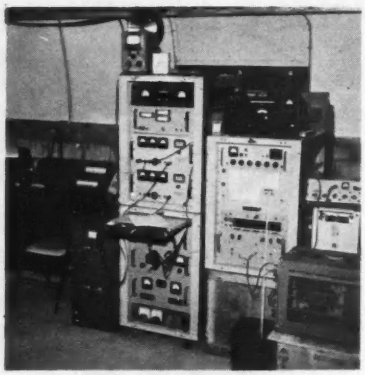
Research at NOTS has resulted in the development of a family of reliable, well tested variable-thrust liquid-propellant rocket motors.

The key to the NOTS variable thrust engine designs is the variable-area injector which permits the thrust to be controlled over the entire range of the engine from zero to its maximum rating. The variable area injector is designed to control the flow of both the fuel and oxidizer simultaneously and in the proper ratio. This control is achieved through the motion of a single part. Engines with as little as 10 lb. maximum thrust and as much as 3,500 lb. maximum thrust have been tested. In all cases, control has been smooth over the entire thrust range. An engine of 20,000 lb. maximum thrust is now under construction. The ability to control these engines is illustrated by tests in which the motors have been cycled from full off to full on at rates greater than 10 cycles per second. Investigations have been carried out to apply the variable thrust techniques to a restartable, "canned" liquid-propellant rocket motor.

The result of this combination of techniques is a fully flexible, reliable rocket propulsion system that could be controlled remotely or by an instrument system like the optical sensor proposed for soft-landing control.

Soft-Landing Optical Sensor

The soft-landing system uses proven optical sensing devices, similar to the ones used to synchronize film movement with ground movement in modern aerial cameras with a simple timing- and attitude-control device; the sensor, combined with the variable-thrust rocket motor, forms a simple, effective, reliable soft-landing system.



NACODE SATELLITE TRACKING STATION
(including operating console)

GUIDANCE AND CONTROL TECHNOLOGY

In addition to the ingenious soft-landing system, NOTS has developed capabilities in inertial guidance and nutation damping controls.

NOTS Inertial-Guidance Systems

The Station has developed and is testing a complete inertial-guidance system. The system in its present state is adequate for missile and earth satellite applications. For lunar-probe applications, it would require additional, optically or electronically generated, data.

NOTS has the capability to design, construct, test and evaluate inertial platforms and related components.

Nutation Damping Systems

NOTS personnel have had experience in the field of nutation damping (that is, making the axis of symmetry of a spinning vehicle coincide with the angular momentum vector). Such a system is useful in any application where a stable, spinning payload is necessary, including such applications as optical and infrared satellite scanning systems dependent on vehicle spin for the "sweep".

SATELLITE SYSTEMS: NACODE

Nacode, Navy-correlation-detection receiving station, is used in the Transit satellite program to provide accurate tracking data from many global locations.

The 4,000-lb. Nacode tracking station can be moved a third of the way around the world, set up and operated within 48 hours of departure time. It requires a four-man operating crew, one third the personnel required for previous tracking stations.

Nacode is capable of phenomenal accuracy in pinpointing satellite positions. It achieves its accuracy through a correction unit which cancels the effects of ionospheric deflection of radio waves. It can provide noise-free Doppler-shift data on the frequency of the Transit satellite's transmitter, using a special narrow-band receiver.

The Nacode station was designed at NOTS, and several of the early models were built at NOTS and operated in the field by Station personnel.

RESEARCH AT NOTS

Basic research plays an important part in the NOTS picture. Current projects that have bearing on astronautics include studies of the upper atmosphere, meteor spectroscopy, and infrared astronomical research.

The Upper Atmosphere and NOTS

Three current projects involving study of the upper reaches of the atmosphere encompass airglow studies, measurements of ozone concentrations, and the "twinkle" of stars.

Airglow, light generated by changes in energy states of atoms in the very thin upper atmosphere, is being studied. Measurements of four spectral bands provide information on the composition of auroral phenomena as high as 400 kilometers.

Ozone concentration studies have developed to the "hardware" stage; one crucial experiment will be the launching of a 100-foot space balloon.

NOTS researchers are cooperating with the Smithsonian Institution in a project to measure star scintillation (twinkle) from a stratosphere balloon "satelloid".

Meteor Spectroscopy

Collection of photographically-recorded spectra of meteors is expected to reveal data on the composition of extra-terrestrial objects, information about the upper atmosphere's composition, and data about the behavior of high-velocity objects entering the atmosphere.

Infrared Astronomy

A 20-inch Schmidt photographic telescope will soon augment the 10-inch telescope now in use as part of NOTS' infrared astronomy program. It is planned that ultimately the program will include observation in the spectral region from 0.7 microns to the water vapor cutoff point at 15 microns.

Other Studies

Additional areas of investigation at NOTS that have implication for astronautics include photometric observations of satellites to measure tumbling rates, satellite brightness, and the behavior of high-velocity pellets. Laboratory-produced velocities of 15,000 feet per second are projected as part of the latter study.

NMC
THE U. S. NAVAL MISSILE CENTER, POINT MUGU, CALIF.

NMC ASTRONAUTICS FACILITIES

The work of the Naval Missile Center in the fields of astronautic systems analysis, study of sea-based launching systems, development of tactical probe payloads and booster systems, satellite payloads design, and launch support is being supported by a number of specialized facilities.

Inertial Laboratory

The Naval Missile Center has recently completed construction of a well-equipped inertial laboratory building. For the past two years, NMC personnel have been working in the entire spectrum of inertial guidance and control applications, from design analysis through test planning. Specific achievements of this group include error analysis of the REGULUS II inertial guidance system, studies on erection and alignment of inertial systems, and inertial vehicle stabilization studies. Specialized test equipment available includes a sea-motion simulator, inertial rate tables, and specialized recording and computing equipment. Scheduled for delivery to the laboratory this year is a precision-type centrifuge with accuracies of the order of 10^{-3} g's over the design range of 1 to 20 g's.

Countermeasures Division

The Countermeasures Division of the Naval Missile Center operates the following ground facilities: an electronic laboratory, mobile van-mounted intercept and jamming facilities, and more permanent jamming installations at sites in and near the Naval Missile Center. Airborne facilities include four well-equipped countermeasures aircraft; two A3D-1's, one F3D, and one R4Y. Approximately fifty professional and technical personnel are assigned to this division, which represents probably the most advanced installation of its type in the country today.

The division has carried out design, development, and evaluation work in the field of advanced countermeasures systems. Countermeasures applications to astronautics systems are under investigation at the present time.

Computer and Simulation Facilities

The Naval Missile Center has extensive simulation facilities which are capable of direct application to astronautics studies. The major equipment in this facility consists of three REAC analog computers with a total capacity of 320 amplifiers, a Bendix three-axis flight table which can mount large angle-sensitive components up to 50 pounds in weight, an associated three-dimensional flight simulator, and the Bendix G-15 digital computer with digital differential analyzer accessory. In the near future, the analog computer capacity will be increased by the addition of two REAC computers with an additional capacity of 120 amplifiers. Numerous guidance and stabilization problems in various missile systems have been solved using combinations of the above simulation facilities.

Aerodynamic Test Laboratory

The Aerodynamic Test Laboratory, operated at NMC by the University of Southern California, is one of the major facilities of its type in the Navy. It has a capability of simulating speeds ranging from Mach 0.4 to over Mach 3.5 with altitude variation from sea level to 14 miles and a throat size of 17 by 22 inches. Additions now being installed will extend this capability to simulate a speed of Mach 6.0 and a simulated altitude of over 25 miles with a throat size of 24 by 24 inches. Extensive instrumentation and automatic data recording and analyzing equipment is incorporated into this facility. This facility is used in performing approximately 70 per cent of the Navy's aerodynamic test studies. Nearly all programs concerning supersonic aircraft and missile systems have conducted initial tests here. This laboratory can be used extensively to study the aerodynamic characteristics of astronautic vehicles.

Motor Testing Facilities

There are, at the Naval Missile Center, excellent facilities for testing rocket motors of small and medium sizes. Operating crews have extensive experience in both liquid and solid motor testing. This facility has four restrained firing stands with allied shops including temperature conditioning chambers. This facility also has the advantage of being located on the shore line adjacent to the missile test range, which allows ground launch testing to be conducted. Extensive work has been done here on such motors as the SPARROW III solid and liquid motors, REGULUS I and II boosters, and solid propellant ramjets. Important contributions can be made by this facility in the field of environmental effects upon solid propellant stages. Information can be supplied on characteristics of motors at various temperatures and on the effects upon vehicles of latter stage ignition and burning.

Infrared Laboratory

A well-equipped laboratory supplemented by mobile field measurement units is available at the Naval Missile Center. Achievements of this laboratory group include evaluation of an aerial infrared search unit, development of a missile seeker, background radiation measurements, measurement of turbojet radiation intensity patterns, and applications of infrared detection and tracking in ballistic missile defense studies. Extension of this work to satellite detection and intercept is foreseen.

Test Range Facilities

Unique facilities are available to astronautics programs because of the location of the NMC and its working agreements with the PMR. The range provides complete facilities for supporting flight tests of systems and components. It provides instrumentation for these tests such as tracking equipment (radar, COTAR), communication facilities, impact prediction equipment, extensive telemetry systems for receiving and recording data, recovery capabilities, and extensive data reduction and computation facilities. With respect to astronautics programs at the Naval Missile Center, it provides a complete testing and operating facility at the same location as the program management.

NMC LIFE SCIENCES DEPT.

FACILITIES

There is a unique combination of facilities presently established within the Pacific Missile Range Complex to support a Life Sciences program. First, the NMC is at the center of the Pacific Missile Range which provides range support to the Department of Defense and other designated government agencies. This strategic location is of particular importance since it provides the opportunity for studying, in an operational environment, medical and human factors problems associated with guided missile, satellite and space vehicle operations. It also provides the opportunity to take advantage of available space and weight requirements of test vehicles by substituting biological packs in place of dead weight or empty space.

In support of range operations, there are complete facilities and systems for instrumentation, tracking, telemetry and computer services (including the IBM 709) for data processing, data reduction and data analysis. These facilities will provide the capability for real time monitoring and recording of human factors information for rapid evaluation of physiological status, environmental conditions and display/control data during flight and laboratory simulation operations.

In the technical support area, there is a large staff of professional and technically trained personnel to provide complete engineering services in the fields of aeronautics, electronics, mechanics, materials and applied physics. Included here are shops for fabrication and prototype manufacture of any essential hardware and equipment, with a capability for on-the-spot modification, repair, overhaul, calibration, installation, and maintenance of equipment, devices or systems.

Navy Astro Activities (contd.)
(NMC material continued)

The new Environment Simulation Laboratory will have in the near future a combination of facilities that will greatly augment and contribute to the prosecution of bio-astronautics projects. These facilities will provide a capability for testing components, complete missile weapon systems, and biological specimens under the extreme conditions of shock, vibration, acceleration, noise, humidity, temperature, altitude, and climatic factors. Many of these facilities can be used in combination, as required, to determine the effects of interaction.

Another important contributing factor to a Life Sciences effort is the Systems Analysis and Simulation facility where performance capabilities and characteristics in missile and astronautic operations can be studied and evaluated by means of dynamic flight simulation. Through this facility it will be possible to simulate the flight pattern and all phases of stress that will be experienced by the pilot or astronaut through a preprogrammed automatic control system.

Since one of the primary responsibilities of the Naval Missile Center is to determine the operational reliability of weapon systems, missile evaluation operations provides the opportunity for studying human tolerances and stress factors under exacting conditions. This includes the development of physiological instrumentation during high performance operations, advancing the state of the art in real time display of instrumented operations, and the establishment of criteria for predicting change of state to change of environment. These are important considerations for those concerned with problems of man-machine compatibility, human performance capabilities and limitations, and safety requirements.

The highly developed capability of the Naval Missile Center in the field of serviceability and reliability of guided missile systems and components can be employed on test and evaluation of proposed life support systems under simulated operational conditions.

Extensive aircraft support facilities (including aircraft modification capability) and aircraft of both the logistics and instrumented R&D type are also part of the Naval Missile Center complex.

The requirement to determine the physiological and psychological qualities of selected personnel to endure the conditions of spatial operations must be investigated on a broad front by whatever means and talents available. At the Center, investigations will employ available facilities to expose instrumented animal and human subjects to some of these exotic conditions, in coordination with like efforts in other laboratories.

A program to introduce to the Center the medical and allied disciplines is being implemented to capitalize on these basic capabilities for the more adequate testing of guided missile systems as well as for the conduct of selected applied research, development and test programs for advanced systems.

NMC ENVIRONMENTAL FACILITIES

During the recent evolution of missiles and astronautic vehicles, the paramount role that environments play in affecting the performance and reliability of these machines is becoming increasingly apparent.

It is now generally accepted that after the best theoretical analysis and design has been completed, a laboratory evaluation is essential to establish correlation between theory and practice. Obviously, as these vehicles have become larger and more complex and as the environments they must survive become more varied and intense, the environmental test facilities should be the best that the industry can provide.

Hyperaltitude Chamber

The U. S. Naval Missile Center Environmental Laboratory has a Hyperaltitude Chamber 10 feet in diameter and 18 feet long. This chamber is capable of simulating 500,000 feet altitude. The roughing pumps can evacuate to a simulated altitude of 200,000 feet in 30 minutes and a cryogenic pump reduces the vacuum to simulate 500,000 feet in an additional 10 minutes. This chamber (figure 1) has a clean, stainless steel internal surface with structural strength to hold any vacuum that may be producible with future improvements in low pressure pumping systems. Provisions are made to add other vacuum pumps when improved products are available.

Altitude-Temperature-Humidity Chamber

The Altitude - Temperature - Humidity Chamber is the same size as the Hyperaltitude facility, which can simulate a combination of altitude, temperature and humidity. The altitude capability of the Altitude-Temperature-Humidity Chamber is 150,000 feet and the sea level temperature and humidity limits are —100°F to +350°F and 20% to 95% relative humidity. Electromechanical and mechanical vibration exciters can be placed inside this chamber to provide four major flight environments in combination.

Auxiliary Chamber

A portable Auxiliary Chamber has been designed which can be attached to the door of either the Altitude or Hyperaltitude Chamber. This Auziliary Chamber with its two compartments and three doors can serve as an airlock or a facility for tests on animals or human subjects.

Sea Level Climatic Hangar

A facility built integrally with the Environmental Simulation Laboratory, is a chamber that is approximately 60′ x 90′. The unique feature of this chamber is its capability of being compartmentized into three, four or five areas. By opening the doors, a large chamber can be produced which can accommodate the largest carrier aircraft now in use. Two of the five chambers are each capable of accommodating a missile as large as the POLARIS. The main feature of this flexible compartmentization is the capability of simultaneously creating arctic conditions in one chamber and a tropical environment in an adjoining one. All the chambers are capable of duplicating weather conditions found on the earth producing temperatures down to —65°F up to +165°F, and humidity from ambient to 95%; snow up to 10 inches per hour and rainfall up to 4 inches per hour.

Acoustic Facility

NMC has an acoustic chamber 42 inches square and 15 feet long which can accommodate large components or even small missiles.

This chamber utilizes three Altec-Lansing air-modulated loud-speakers in conjunction with 32 high-frequency electromagnetic speakers to produce frequencies from 1,000 to 15,000 cycles per second.

The unique feature of this facility is the mixing plate that will allow the low frequencies to pass through and the high frequencies to reflect from its surface.

Vibration Facilities

Electromechanical vibration facilities consisting of a Ling-Calidyne electronic system, a 1,750 pound force M. B. shaker, and a number of Calidyne sinusoidal systems are in operation at the NMC.

A 7,000 pound force Ling and the 1,750 pound M. B. shaker heads are liquid cooled and are designed to be used in the chambers for combined environmental testing.

The frequency limitations are 5,000 cycles per second for the M. B., 3,000 cps for the Ling and 2,000 cps for the Calidyne sinusoidal shakers. The NMC also has two mechanical vibration exciters: An L. A. B. shaker that can impart constant displacement tri-axial vibrations to a 100-pound item in the frequency range from 1 to 100 cps and a 10′ x 10′ NMC-designed vibration table that produces constant displacement uni-axial vibration from 1 to 60 cps. The 10-foot table is capable of vibrating a 4,000 pound test load to as much as 2 G's. Higher acceleration levels can be applied to smaller loads with the maximum level at the no-load condition of 10 G's. The present peak-to-peak excursion can be varied from 0 to 0.25 inches. The large area provided by the table makes it possible to vibrate simultaneously small missiles, the test gear, and the checkout personnel, thus simulating shipboard vibration conditions.

THE U. S. NAVAL WEAPONS, LABORATORY, DAHLGREN, VIRGINIA

FACILITIES FOR SPACE TECHNOLOGY

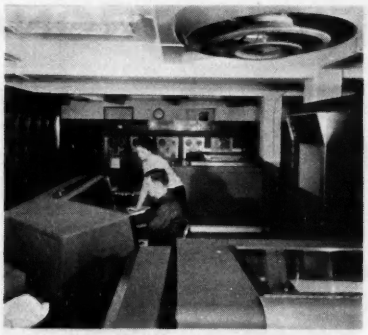
At Dahlgren, on the Potomac River, large strides are being taken in the Navy's astronautics programs, thanks to the staff and facilities of the NWL. This activity's Computation and Analysis Laboratory combines a concentration of more than 150 mathematicians and physicists and the Naval Ordnance Research Calculator, better known as NORC. This digital computer, in operation since 1955, is still one of the world's leading scientific computers because of its ability to compute 13-decimal digit numbers at the rate of 15,000 operations per second. This great word length provides significantly greater span in "life" for the orbits predicted. In August, 1960, Dahlgren's computation capability will be increased by the addition of an IBM 7090.

NORC's orbit prediction performance may be illustrated by its ability to provide numerical integration of 2 days' real time in just one minute of NORC time, and with an accuracy of plus-or-minus thirty feet.

ASTRONAUTICS AT DAHLGREN

Astronautics at Dahlgren is largely a natural development from ballistics experience. The considerations involved in determining range and firing tables for 16-inch guns were essentially duplicated in early guided missile development. The familiar effects of atmospheric drag, velocity, gravity, wind and rotation of the earth were incorporated in fairly sophisticated mathematical models and test flown in NORC. This experience paved the way for developing computer programs to the next advancement in weapons, the ballistic missile such as POLARIS. Dahlgren's existing computation programs and techniques were successfully applied, with modifications, in determining satellite orbital elements.

Several VANGUARD computation areas were assigned to Dahlgren in 1957. An early problem was an investigation of the mechanics of the separation from the rocket body of a spinning bottle loosely coupled with a satellite. Another VANGUARD assignment included reduction and analysis of Minitrack data obtained during and immediately following third stage burning. The purpose of the analysis was to obtain third stage thrust performance data and, incidentally, to back up the VANGUARD Computing Center predictions. Dahlgren scientists achieved increasingly rapid and valuable results in this pioneering era, once again with credit largely due to experience developed in earlier generation of weapons.

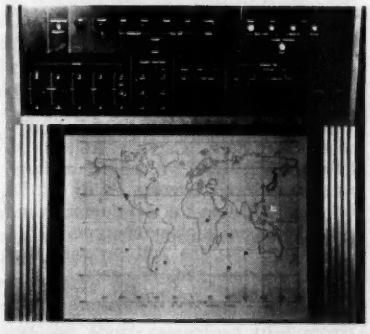


NORC Computer at NWL, Dahlgren, Va.

Directly stemming from these VANGUARD tasks, further roles in astronautic activities were given Dahlgren. Mathematical models in ever increasing amounts were flown on NORC in the search for optimum design for space vehicles. Concurrently, increased effort in satellite launchings during 1958 brought NORC's staff and capability into demand for computation of orbital elements. Two of the Navy's major astronautic responsibilities, the Space Surveillance System and TRANSIT utilized Dahlgren's Computation and Analysis Laboratory from the very early stages. The Navy's Space Surveillance Operations Center was physically located at Dahlgren in 1959, and has developed into a sizeable enterprise. TRANSIT studies, prior to actual launching, were also rather large in terms of requirements for staff and computer time. Successful launchings of TRANSIT vehicles have increased Dahlgren's supporting role, and when the injection phase is in operation, substantially further demand for computation services must be met.

PROGRESS ON TRANSIT DATA

Since the launching of TRANSIT 1B, Dahlgren has been reducing all the Doppler data on TRANSIT satellites on a 24-hour basis, and producing orbit predictions for station alerts for the TRANSIT tracking stations. A significant contribution was made earlier this year by C. J. Cohen and R. J. Anderle in using TRANSIT 1B data to confirm the "pear shaped" earth discovered by Dr. J. A. O'Keefe and associates as a result of VANGUARD I observations. In addition to providing independent confirmation of the earth's hemispheric asymmetry, the data also yielded improved knowledge of the density structure of the atmosphere.



SPASUR cathode ray tube printer, on-line with NORC, can display results eight seconds after computation by NORC. Here all satellite positions for a particular minute are shown on a world map.

SPACE SURVEILLANCE

Space surveillance computations at Dahlgren are concerned with processing the observations of known satellites in order to make accurate predictions of their future "fence" crossings. This is necessary so that signals from new satellites may be discriminated from those of the knowns. When new satellites are detected, their orbit elements are determined and they are added to the catalogue.

Astronautic computations at the Naval Weapons Laboratory are aided substantially by two major pieces of equipment associated with NORC—the on-line Cathode Ray Tube Printer and the off-line Universal Data Transcriber. The CRT Printer displays information at the rate of 15,000 characters per second on a charactron cathode ray tube in one or a combination of three different modes—alphanumeric mode, numeric mode, and plot mode. The contents of the cathode ray tube are then photographed on microfilm. Using the self-processing camera, results are displayed on a screen within eight seconds after computation to allow monitoring the progress of the problem on NORC, or are available for use on a viewer. Related microfilm processing equipment produces printed copy at the rate of five pages per minute.

The Universal Data Transcriber, developed at Dahlgren, rapidly converts teletype transmissions of satellite observations into NORC language and conversely converts NORC predictions or alert data into teletype messages. This unique equipment, essentially a stored-program computer, accepts digital data from cards, paper tape, or magnetic tape of NORC, UNIVAC, IBM 704, 7090, and can produce out-put in any desired format. This flexibility is unmatched and provides Dahlgren with a unique data processing capability.

LINK IN LARGE NAVY NET

Communications facilities have kept pace with astronautic developments. A system of direct leased lines tie Dahlgren to the Applied Physics Laboratory for TRANSIT; to the Naval Research Laboratory and the Space Surveillance System transmitting and receiving stations; and to the NASA Control Net. The communications center at Dahlgren, located in the Computation and Analysis Laboratory and manned by military personnel, also provides a direct link to the Navy's communication network. ■

NAVY BIO-ASTRONAUTICS

THE U. S. NAVY possesses an extensive ability in the field of Bio-Astronautics. Concentrating over the years upon the development of an in-house capability for the research, development, test, and evaluation of airborne personnel equipment has resulted in devising and installing unique and spectacular equipment and facilities at Navy laboratories and field activities. Possession of this equipment and progressive and well-planned research programming have attracted a select number of world renown scientists, engineers, and associated professional members of the aeromedical fields to these laboratories, augmenting the military scientific staffs.

CENTERS IN PENNSYLVANIA

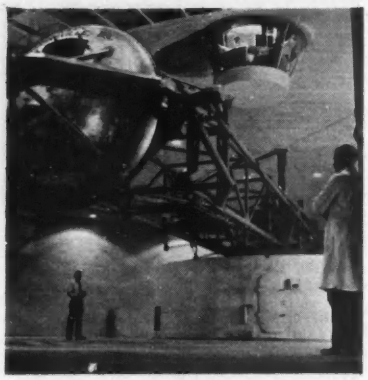
Rear Admiral Edward A. Ruckner, USN, Assistant to the Chief of the Bureau of Naval Weapons for Research, Development, Test, and Evaluation, acts in management control of two of these laboratories, the Aviation Medical Acceleration Laboratory at the Naval Air Development Center, Johnsville, Pennsylvania; and the Air Crew Equipment Laboratory, Naval Air Material Center, Philadelphia, Pennsylvania. Programming and monitoring the bio-astronautic projects for these two laboratories are performed by Captain Walton L. Jones, MC, USN, Aero-medical Assistant to the Director of the Airborne Equipment Division.

COOPERATION WITH OTHER ACTIVITIES

Two other laboratories, the Naval Medical Research Institute at the National Naval Medical Center, Bethesda, Maryland, and the Research Department of the U. S. Naval School of Aviation Medicine, Naval Aviation Medical Center, Pensacola, Florida, contribute heavily to the Navy's and our nation's Man-in-Space efforts. Both are under the management control of the Bureau of Medicine and Surgery. Rear Admiral Calvin B. Galloway, MC, USN, Assistant Chief for Research and Military Medical Specialities, and Captain Clifford P. Phoebus, MC, USN, Director of the Bureau's Astronautics Division, support, maintain, and monitor the Navy Medical Department's bioastronautics program.

ONR IS INVOLVED

The Office of Naval Research is involved to some extent in the Navy's aerospace program. Captain Joseph P. Pollard, MC, USN, Special Assistant for Medical and Allied Sciences to the Chief of Naval Research programs and monitors this department's projects in the aerospace medical fields, most of which are carried on through contracts with universities and industrial laboratories.



Centrifuge at Johnsville

AVIATION MEDICAL ACCELERATION LABORATORY

Captain F. Kirk Smith, MC, USN, Director of the Aviation Medical Acceleration Laboratory, and Dr. James Hardy, Director of Research for the laboratory, head up an outstanding staff of military and civilian bioscientists. Here the efforts of various acceleration forces on man are studied through the use of the world's largest and most versatile human centrifuge. By combining the centrifuge with the Aviation Computer Laboratory's remarkable analogue computor, "Typhoon," the Navy has created a dynamic flight simulator with which complete flight patterns of existing and proposed aircraft can be "flown." A pilot within the centrifuge gondola can experience complete acceleration and instrument reactions to his control maneuvers as well as the preprogrammed flight patterns. Here restraint and containment systems are devised and tested; studies of acceleration forces on the body in complete water submersion are run; and the development of biopack systems, life support subsystems, vehicle control and instrument display systems, and other bioastronautics research and development project programs are pursued.

AIR CREW EQUIPMENT LABORATORY

As Director of the Air Crew Equipment Laboratory, Captain Roland A. Bosee, MSC, USN, relies to a large extent on the engineering ability of Ed Hays for directing the development and testing of closed ecology concepts of life support systems, the full pressure suit, crash protection, and, in general, space craft personnel equipment. Utilizing several large low pressure chambers with high performance explosive decompression features, studies in psycho-physiological response to long term isolation by multi-manned crews while utilizing a closed life support system with a solid oxygen source at lowered atmospheric pressures have resulted in significant progress in space craft technology. Electrolytic and electro-chemical production of oxygen from body waste products are underway. Development in fire and capsule integrity failure detection and repair systems is progressing. Development and testing of new concepts in communications, impact and crash protection, radiation, microwave and thermal protection, and environmental control systems occupy much of this laboratory's efforts.

NAVAL MEDICAL RESEARCH INSTITUTE

Captain Otto E. Van Der Aue, MC, USN, is Commanding Officer of the Naval Medical Research Institute. Here basic research into the effects of heat, vibration, gases, and other physical hazards that threaten the astronaut are studied. Using low pressure chambers, shake tables, human full body calorimeters, and simulated ship compartment for gaseous physiology studies are available for fundamental research problems in human physiology.

NAVAL SCHOOL OF AVIATION MEDICINE

Captain Langdon C. Newman, MC, USN, Commanding Officer, and Captain Ashton Graybiel, MC, USN, Director of Research, U. S. Naval School of Aviation Medicine, are responsible for a rather comprehensive basic and developmental research program in bio-astronautics. Studies of human reaction to tumbling and simultaneous multiple acceleration forces using the new and unique Human Disorientation Device and centrifuge are beginning to show unforeseen results. Using a slow rotating 15 square foot room, bioscientists are studying effects of rotation on work performance and long duration tolerance to rotating vehicles. Development and testing of sound attenuation and protection devices are producing new and acceptable equipment. Here advanced work in spacial radiation, non-ionizing radiation, and heavy particle concentrations and their effects are progressing well in advance of our national Man in Space Program. Development of small animal and primate biopacks for probes and orbital vehicles with associated electronic systems for telemetric transmission of physiological and environmental data is being expanded following the successful Jupiter biopack shots of the monkeys, Gordo, Able, and Baker.

SUMMARY

Thus, the Navy, through its aviation medicine research and development facilities, has reaped a natural ability to assume a leading position in the biotechnical support of man in space. ■

. . . Straight talk to Sales Management

Building Realism into Systems Sales Forecasting

by Pat Thomas/DATA

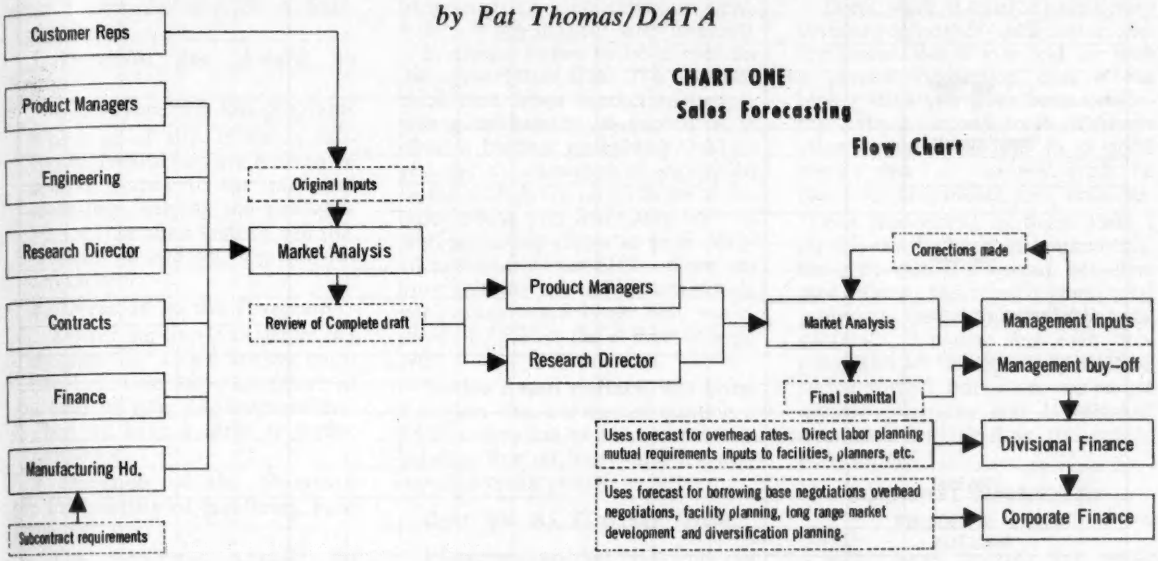


CHART I. (Fig. 1) FLOW CHART OF SALES FORECASTING PROCEDURE

AN ANALYST'S reputation is as good as his last forecast and I'm sure that most DATA readers saddled with the responsibility of sales forecasting will agree that you just never get over that queasy feeling when forecast time rolls around again.

My experience has been entirely in the field of system sales and as I only write from experience, this article may not be too helpful for those of you in the component field. However, the same basic method should in part apply.

The choice of the title for this article was not merely intended to catch your eye with that word "realism." As a former staff assistant to a corporate controller I had the responsibility of preparing corporate sales forecasts based upon marketing inputs which were 80% optimism and 20% realism. My dear marketing colleagues, do you have any idea just how big a mountain of detail follows your estimates?

BASIC SALES FORECASTING

There are four basic financial statements that most corporations prepare on a quarterly basis:

1. *Cash Receipts and Disbursements*
2. *Source and Application of Funds*
3. *Profit and Loss Statement*
4. *Balance Sheet*

Your sales estimates are broken down into direct labor by basis category, materials estimates are made, overhead applied, there may be a complicated withholding pool to contend with, the lag between billings and cash receipts has also to be calculated, taxes, etc. It amounts to that inverted pyramid of activity mentioned in our June DATA article on customer orientation.

It all boils down to one basic point: **It is mandatory that you approach sales forecasting as studiously and conscientiously as those who must take over where you leave off!** It will do you good to sit down with the financial people and see their operation in context with yours.

I'm on the other side of the fence now and am now responsible for forecasting sales potential of major military electronics contracts and prime contractors involved. The system I utilize is in no textbook—it works well for us—and I share it gladly with you. You notice I said *potential* sales. Firm and programmed business is the responsibility of the Finance Dept. at our company. Programmed business by our definition is *customer programmed* and is, therefore, on the firm side as the customer has bought off on the cost estimates.

THE APPROACH

My approach is based upon the following premises:

1. Conservatism is mandatory. Burden rates must be pre-sold to the military and failure to meet your sales goals drives up burden and the AFPR's blood pressure. *(Besides, no one kicks when sales exceed the forecast . . . but Oh! Listen to them beef when you under shoot!)*

2. When all identifiable opportunities are included you automatically build into your forecast self-cancelling error. (A jet transport's weight can be guaranteed

Division _____

Product Area _____

Forecast Date _____

Excludes Firm and Programmed Business — $ in 000's

CHART II

Sales Forecast 1961 - 1965

Item Prime	Proposal No. & Date	Five Year Potential	Probability of			Derated Five year Potential	Fiscal Year 1961				Fiscal Years				
			Award to prime	Award to us	Full Potential		1st qtr	2nd qtr	3rd qtr	4th qtr	1961	1962	1963	1964	1965
Programs															
Sub Total															
Open Proposals															
Sub total															
Pre Proposal Programs															
Sub total															
Grand Total															
Absolute															
Derated															
Percent realization															
Explanatory Notes															

CHART II (Fig. 2) FIVE YEAR SALES FORECAST PLANNING

within 2% because weights are tabulated for each part down to the nuts and bolts.)

3. The Sales Forecast should be built upon the inputs of Marketing, Engineering, Manufacturing and First Tier Management. (I'll explain this later in this article.)

4. In the Five Year Forecast its the first two years which really count. (It's difficult enough to look 10 minutes ahead and management, for the most part, is fiighting limited — not total — war. Naturally, I'm not depreciating the necessity for a careful five-year look, but rather emphasising the importance of helping management in the time period where most of their decisions apply.)

5. The Sales Forecast should be a working tool for Sales Management. *Don't smooth out the curve in the basic forecast—if you do, you cloud the picture as to where projected backlog increase is required to meet sales goals.*

6. Simplicity is essential. You are kidding yourself when you spend time correlating sales with GNP—and the use of fancy statistical techniques usually confuse management. They may not argue with you but they also may not believe you because they don't understand your methods. The consumer and industrial goods market forecasters make effective use of multiple correlation, etc., but I've never seen it work well in our inherently unstable Defense business.

THE FIVE YEAR FORECAST

On Chart II (Fig. 2) you will notice that we are forecasting sales for a five year period with the current year by quarters. I do this every three months for the corporation I'm associated with.

Three categories of programs are forecast: I call them simply

1. Programs

2. Open Proposals

3. Pre-Proposal Programs

Programs are funded contracts. For these I include only the business which is still potential. Open Proposals should be self explanatory. Pre-Proposal Programs are opportunities we are working on but haven't proposed as yet, or are identifiable but further out in time. It's a pleasure to watch a Pre-Proposal Program move into the Open Proposal, thence to the Program stage—needless to say.

No one in the company knows better than the market analysts what the five year potential of a given weapon system might offer for each product area and this is

why I believe *potential sales forecasting is properly the prime responsibility of Market Analysis.*

THREE BASIC DERATIONS

After estimating the Five Year Potential for a given program within each product area, I derate it for what I consider the *three basic probabilities:*

1. Deration for Award to Prime

Will anyone win this program? Will it go at all? If we as subsystem contractors are bidding to several primes (I list each bid separately, varying the probability, i.e., cleration factor) will this program go and will it go to this contractor?

2. Deration of the Program

My second step is to derate the program for award to my company. Say we are competitive in a field of four (4) competitors. Then we have a 20% or better probability.

3. Deration of the Program for Probability of Realizing Full Potential

Few programs actually do reach full potential these days. Many programs don't get past the R&D stage. It is important to derate the program with this factor as fully explored as possible.

15% REALIZATION OF DOLLARS

Each of the above derations is designed to make you approach the program from a conservative viewpoint. When making sales forecasts it is always better to be a hair on the conservative side. But I've noticed that when marketing people give a probability of success it is often a blanket probability. When you ask the salesman or analyst to assess probability on all three of the bases above you invariably end up with something closer to 10% overall probability than 50%. *Even the most selective companies usually do not average much better than realization of 15% of the dollars they go after.*

Notice I said dollars, not bids. I suspect that companies quoting a 25% realization of success are calculating this on bids—and it's dollars that make profits.

CALL 'EM AS YOU SEE THEM

I have noticed that invariably my Derated Five Year Potential for each category varies in *Percent Realization* in descending order. By this I mean that "Programs" ends up with a better percent realization than "Open Proposals" and "Open Proposals" has a better realization than "Pre-Proposal Programs." The reason is obvious and I mention this as a useful checking device.

Don't work toward a satisfactory percent realization—call 'em as you see them. But if you end up with a percent realization that is far higher than you have been achieving, take a second look. Perhaps your optimism is due to a good night's rest . . . in any event be ready to *substantiate* your opinions.

For the Spread of Sales (and I do this on the basis of booked out-the-door sales) I spread non-derated values. My derated grand total represents the summation of derated subtotals. I realize that each program should be separately derated in the spread, but when you've got umteen programs and 10 product areas and too little time, this gets to be tiresome.

POTENTIAL BUSINESS BY PRODUCT AREA

After going through this whole process for each product area I then make a summary cover sheet which

CHART III (Fig. 3) POTENTIAL SALES FORECAST

Division _____

Forecast Date _____ $ in 000's

Potential, Firm and Programmed Business Summary

CHART III

Potential Sales Forecast

Product Area	Non Derated five yr Potential	Derated five year potential	Percent realization	Percent of Total Sales	Fiscal Years				
					1961	1962	1963	1964	1965
Potential Business						Derated Potential			
Total Potential	XXX	XXX	%	%	$ XXX	$ XXX	$ XXX	$ XXX	$ XXX
Firm Business					$ XXX	$ XXX			
Programmed Business					$ XXX	$ XXX	$ XXX		
Grand Total					$XXXX	$XXXX	$XXXX	$XXXX	$XXXX
From Finance									

CHART IV

Division _____

Forecast Date _____

Excludes Firm and programmed business $ in 000's

Sales forecast 1961 - 1965 Variances in potential, This quarter over last quarter

Non derated and derated potentials

Product Area	Fiscal Year 1961			Explanation See Attachment	Fiscal Year 1962			Explanation see Attachment
	Last qtr	This qtr	difference		Last qtr	this qtr	Difference	
Non Derated Potential								
	$	$	$	Item 1	$	$	$	$
				2				
				3				
				4				
				5				
				6				
Totals	$ XXX	$ XXX	$ XXX		$ XXX	$ XXX	$ XXX	$ XXX
Derated Potential				Item 1A				
	$	$	$	2A	$	$	$	$
				3A				
				4A				
				5A				
				6A				
Total	$ XXX	$XXX	$ XXX		$ XXX	$XXX	$ XXX	$ XXX

CHART IV. (Fig. 4) VARIANCES IN POTENTIAL

sets forth potential business by product area—and this time I carry forward the derated spread. See Chart III (Fig. 3).

ARRIVING AT EXPECTED SALES

Adding the firm and programmed business for each product area yields total business by product area. The summation of this is Expected Sales.

THE DESIRABILITY OF DERATING FIRM AND POTENTIAL SALES

Some of you may desire to derate firm and potential sales. Frankly, I don't have the time to do so. Just wading through the potential takes me two solid weeks and I question the validity of techniques which imply greater accuracy than the bases for opinions justifies.

In the process of arriving at this stage I have set down with or interviewed by phone each customer representative, studied the cost itemization on each proposal cover letter, consulted with each Product Manager, the Research Director, and the game has long lost its savor.

FIRST TIER MANAGEMENT

At this point I sit down with "First Tier Management" and they review the forecast. I find this to be the acid test. Often management has cards they are playing quite close to their chest. Opportunities on a given program are better or worse than you estimated due to facts they know that you aren't aware of. This is the point at which "Management Emphasis" enters the picture. Your potential may be absolutely correct but management may prefer to de-emphasize a certain product area, etc.

For this management review I prepare a summary which sets forth by product area the current and last quarters derated and non-derated potentials as shown on Chart IV (Fig. 4). Significant variances in potentials are explained providing a basis for fast review.

SUMMARY AND IMPORTANT POINTS

Some final pointers:

1. By including only identifiable opportunities this type of forecast can be an effective guide to sales management. If your company is achieving 15% realization on the dollars it goes after then you need seven dollars potential in the forecast for each derated dollar. The probability should reflect relative sales emphasis.

2. This type of forecasting is not based upon the total present or projected market for a given product area, but rather the projected available market, which is a far more realistic measure. Certainly your company should have definite goals for market command as well as knowing its current position. The way to approach the determination of realistic market command goals is to analyze available opportunities (as we are doing by this forecasting method) and compare this with a projection of the total market. There is an interesting point to be made in this connection: *A company may be satisfied with its growth but be unaware that the market is growing faster than they are!*

This translates into continued loss of market command. Much more common are the cases of over-optimism. I am quite certain that if all sales forecasts for a given product area were added together the result would be a doubling or trebling of the true size of the market. This is because most companies are seeking to control an increased percentage of the market. The truth is that in most businesses you have to run as fast as you can just to keep your current position.

3. Growth comes from only three wellsprings:

(a) Research and Development

(b) Mergers and Acquisitions

(c) Licensing (bi-lateral)

Into my forecasts I build a positive corelation between the R&D program and sales by product area. By going over my total market projections and identifiable opportunities with the Director of Research we work out the potential sales estimated to spring forth from the in-house and funded R&D programs. (I will go much deeper into this subject in a forth coming article).

As for mergers, acquisitions or licensing arguments, in my particular case these matters are not within my responsibility. These sources of growth, however, may be necessary to achieve overall corporate growth goals and it is the responsibility of market analysis to present comprehensive marketing data that allows management to judge whether mergers, acquisitions or licensing arguments are necessary to the achievement of goals.

Editor's note: Mr. Thomas welcomes specific marketing questions or general reader inquiries. Send your specific problems or questions to Pat Thomas, Defense Marketing Forum, DATA Magazine, Dupont Circle Building, Washington 6, D. C.

Following the candidate's trail

The presidential hopeful was stumping the Indian reservation. He addressed the council of elders and a vast pow-wow of braves, squaws and maidens at the reservation.

"And, my dear Indian friends," he went on, "If I'm elected I'll see that every teepee has air conditioning."

A great shout of "Hooyah!" went up from the crowd.

"And, my dear Indian friends," the politico continued, "if I become your Great White Father I'll see that every teepee gets a television set."

Another great shout of "Hooyah!" went up from the crowd.

"And, dear Indian friends," the candidate continued, "if I get into office I guarantee that I will see that new ponies, roads and schools are provided by the Government to this reservation."

More and louder cries of "Hooyah!"

Finally the politician finished his oration. The chief thanked him for making such a fine speech and then offered to take him on a tour of the reservation. "First," said the chief, "I like show you our fine stables and beautiful horses of which we heap proud. Just be careful as you walk around not to step in any 'hooyah'."

* * *

Budget cut

A Washington critic was getting ready to give a new statue the works in his column when the sculptor came by. The critic commented that it was fine work, but he just couldn't see why the sculptor had put the General in such an odd undignified position. The sculptor explained, "You see it was this way. I was half way finished with the original plan when the committee decided that they couldn't afford a horse for the General."

* * *

Good recipe

There is a good recipe to make a peach cordial. It's simple, man. Buy her a drink.

* * *

Cagey answer

The prim and proper school mistress was taking her class on a field trip to the zoo. When the group came to the monkey cages, the expected high point of the trip, the class and teacher were disappointed to find the play areas deserted.

"Oh my good man," the school mistress hailed to the zoo atendant, "Can you tell me where we can find the monkeys?"

"Well, Ma'am," said the keeper instructively, "this time of year happens to be their mating season and that's what they're doing back in their little houses behind the play areas right now."

"Well," countered the school woman hopefully, "Do you think they would come out if I threw them a few peanuts?"

"Begging your pardon, Ma'am," answered the keeper, "but would you?"

Alladin's genie sees the light

Two old maids rumaging in a Georgetown antique shop discovered what appeared to be Alladin's Lamp.

Rushing home, they locked their apartment door and examined their treasure. One of the old girls gingerly took the lamp and rubbed it excitedly. Sure enough, a genie wafted out of the lamp, stretched himself up to his full seven-foot height, waved his arms in the air and said, "Hokus Pokus, Hokus Pokus."

The other old maid snapped impatiently, "To hell with this Hokus . . ."

* * *

Pentagon desk signs we liked

I try to be humble . . . but it's difficut when you're as great as I am.

I don't always think about women . . . but when I think, I think about women.

Flying is made up of hours of boredom broken by moments of sheer stark terror.

If you want it done by Friday don't look at me, find Robinson Crusoe.

If you want to see someone with a little authority see me . . . I've got about as little as anybody.

If the boss calls, get his name.

I'm certainly not conceited . . . though I have every right to be.

Six munce ago I cuddent even spel pilot, and now I are wun.

* * *

Tough world

It seems like one American businessman was overheard telling another: "It's a tough world. Every time you come up with something new, the Russians invent it a week later and the Japanese make it cheaper."

* * *

We heard

. . . about a Russian visitor who checked out of a Chicago hotel in a huff. Seems he thought he would be staying at the Comrade Hilton.

. . . about a conceited nurse who always subtracted five beats from a male patient's pulse in deference to her own presence.

. . . about a chap who claimed the reason why he talk[ed] so long and rapidly was based upon his heredity. His father was an auctioneer and his mother a woman.

. . . about the Christians in ancient Rome who had problems similar to today's company presidents: something was always eating up their prophets.

. . . about a sign in a New York bar which reads: "In case of atomic attack: Keep calm. Pay bill. Run like hell."

. . . about a scientist who crossed a parakeet with a tiger. He doesn't know what he's got but when it talks he sure listens!"

. . . about the wall flower who was a dandy lion in bed!

DATALOG OF MISSILE, SPACE, AND DETECTION PROJECTS

MILITARY MISSILES, AUGUST 1960

★ *New information this month*

AA—Air-to-Air
AS—Air-to-Surface
AU—Air-to-Underwater
SS—Surface-to-Surface
SA—Surface-to-Air
SU—Surface-to-Underwater
UU—Underwater-to-Underwater
ICBM—Intercontinental Ballistic Missile
IRBM—Intermediate Range Ballistic Missile
ECM—Electronic Countermeasures

ARM AF WS-121B
Type: AS
No contracts announced.
★ ARM is said to replace cancelled CROSSBOW. FY '60 funding $23 million. Anti-Radar Missile.

ARROW Army
Type: AS
prime: Grand Central Rocket
guide: Unguided
power: Grand Central Rocket
Launched from helicopter or medium-weight Army a/c, ARROW rocket motor burns out at from 5000 to 7000 ft and coasts upward to apx. 45,000 ft. With a 6-lb payload, separation is req from 5000 to 7000 ft in order for this payload to coast upward to 120,000 ft. Payload is needle-nosed enlarged to apx. 2 in O.D. and enters target area almost vertically. Ideal surprise attack weapon.

ASROC Navy
Type: UU
prime: Minn.-Hon. Dia: 1 ft.
length: 15 ft. weight: 1000 lbs.
guidance: stabilizing fins
Development cost $65 million. ASROC equipped ships locate & track subs, computer charts course, range, and speed of sub and aims launcher. Ship commander orders fire of missile with either torpedo or depth charge payload. Missile follows ballistic trajectory to target area. During flight rocket motor and air-frame drop off at pre-determined signal, controlling trajectory. Depth charge payload sinks and detonates at predetermined depth. Torpedo payload is eased into water by parachute and attempts to locate sub by acoustical homing search pattern.

ASTER Navy
Type: SU
prime: Applied Physics Lab/Vitro
guide: Ford
power: Allgheny/Rocketdyne
range: 30 mi.
Ship launched TERRIER carries ASW torpedo to surface destination, where torpedo drops off for attack. May replace SUBROC. Now in R&D.

ATLAS SM-65 AF
Type: ICBM prime: Convair
guide: GE/Burroughs/Am. Bosch
power: North American
nosecone: GE length: 75 ft.
weight: 260,000 lbs. dia: 10 ft
range: 5500 naut. mi.
★ Official AF claims operational date before Sept '60. ATLAS squadrons will cost $152 million apiece. ATLAS shot of 9 Aug was second longest in military records. It traveled 7000 mi. Rocketdyne's new MA-3 propulsion system has passed AF test. The lighter, more powerful system will power advanced series "E" Atlas.

BOMARC IM-99A IM-99B AF
Type: SA
prime: Boeing power: A—Marquardt
guide: Westinghouse B—Thiokol
funding: $421.5 million on BOMARC-B in FY 61
speed: Mach 2.7
range: (A) 200+ mi. (B) 400+ mi.
★ McGuire AFB, N.J.; and Otis AFB, Mass., will both receive 28 BOMARC-B missiles and launchers to complement their units of BOMARC-A. These are the first announced sites for BOMARC-B.

BULLPUP ASM-N-7 Navy
Type: AS
prime: Martin
guide: radio command/Republic
power: Thiokol
weight: 250 lbs. range: 2.5 mi.
★ Now more versatile with proved capability for helicopter launch. Could provide Marine assault troops with additional offensive firepower. See WHITE LANCE for AF version.

CALEB Navy
(See Space Projects) Type: AS

CLAM AF power: Ramjet
No contracts announced.
★ Chemical Low Altitude Missile listed in AF missile specifications book. Was in study and Research phase, may now have been cancelled in favor of SLAM.

COBRA USMC
Type: SS
prime: Boelkow Entwicklunger, W. Germany (distrib. U.S.: Daystrom)
guide: wire guided
power: Solid BE speed: 191 mph.
weight: 24.6 range: 1 mi.
Daystrom is turning out 1000 COBRAS a month for USMC. Possibility that Army will buy COBRA very strong now that SS-11 is ruled out.

CORPORAL SSM-A-17 Army
Type: SS power: Ryan
prime: Firestone speed: Mach 3.5
guide: Gilfillan range: 75 mi.
Giving way to SERGEANT. Many CORPORAL birds being used as targets for NIKE family.

CORVUS XASM-N-8 Navy
Type: AS prime: Temco
guide: Texas Instrument
power: Reaction Motors
range: Over 100 mi.
★ Navy has cancelled the CORVUS program, after spending an estimated $80 million. The cancellation came just weeks after CORVUS had made its first successful complete flight test. No announcement as to what will replace the program has been made.

CROSSBOW AF
Type: AS
prime: Northrop power: Westinghouse
guide: Bendix range: 200 mi.
★ Reported to have been replaced by ARM.

DAVY CROCKET Army
Type: SS
prime: Rock Island Arsenal
FY '61 production funds: $20.6 million. Bazooka-launched, can be hand-carried or truck mounted. Has low nuclear yield warhead. DAVY CROCKETT has alternate range by switching launching tubes. However, experts feel that range is limited to 3 or 4 miles. Shell characteristics are classified, but educated estimates place weight at 50 lbs; caliber of 5 in; length of 30 in. Will be delivered to NATO in '61.

EAGLE JAAM-N-10 Navy
Type: AA
prime: Bendix
guide: Bendix/Sanders
power: Aerojet
speed: Mach 4
range: 100 mi.
★ Douglas won contract for "Missileer" a/c launching platform for EAGLE. These subsonic a/c will be carrier based—to fly continuous alert around ship. Dvlpmt cost estimated at apx $3 billion for EAGLE missile and a/c.

FALCON GAR-1, -2, -3, -4, -9, -11 AF
Type: AA power: Thiokol
prime: Hughes speed: Mach 2+
guide: Hughes range: 5 mi.
GAR-3 is operational, SUPER FALCON GAR-3 in test. GAR-2 and 4 are infrared guided. GAR-9 is radar guided with nuclear warhead. Long range GAR-9 now being cut back in production. GAR-11 soon to be installed on F-102 Delta Daggers, giving them nuclear capability. F-102 will also carry GAR-10 and GAR-2A.

GENIE MB-1 AF
Type: AA power: Aerojet
prime: Douglas speed: Mach 4
guide: Hughes range: 1.5 mi.
Now being carried by F-89J, F-101B and F-106. First operational nuclear warhead air-to-air bird, GENIE is pointed downward at launch, curves up at target. Being replaced by guided FALCON missiles.

HAWK M-3 Army
Type: SA
prime: Raytheon power: Aerojet
guide: Raytheon range: 22 mi.
★ HAWK intercept of LITTLE JOHN, 27 July, proves feasability of law altitude aircraft interception. FY '61 production funding $97.4 million.

HONEST JOHN M31, XM50 Army
Type: SS prime: Douglas
guide: unguided
power: Hercules Powder/Thiokol
range: 12 mi.
★ FY '61 funding $22 million. Latest contract to Bendix—$2 million for fuze adaption kits. Improved XM50 model has increased range.

HOUND DOG GAM-77 AF
Type: AS
prime: North American
guide: Autonetics
power: Pratt & Whitney (J52)
funding: $170 million in FY '61
speed: Mach 1.7
range: 500+ mi.
★ Comparable Soviet missile is said to be USSR's KOMET D. Longer range version is two-stage XGAM-87A, now in R&D. 500 mi. flight of 1 Aug. one of most successful to date.

PROJECT HYDRA Navy
Type: Sea launch platform
Obj: Test feasability of launching missiles from sea platform
★ Concept of spar buoy (vertical-floating) launch for large solid-propellant rockets. Advantages are:

DATALOG OF MISSILE, SPACE AND DETECTION PROJECTS

MILITARY MISSILES, AUGUST 1960

★ *New information this month*

2

1. Rocket boosters of any size may be easily transported, erected, and launched with practically no special handling equipment.
2. Mobility is unlimited over the surface of the oceans, and the rockets can also be fired from rivers and lakes of sufficient depth to float the rocket vertically.
3. The launch pads are free, water-cooled, and self-healing.
4. Launch safety is greatly increased, since the rocket is surrounded by water at launch.
5. Range safety and booster fallout problems are almost eliminated by proper choice of launch location.
6. Launch pad availability being unlimited, the scheduled launch rates can be higher than those of a land-based launch complex.

JUPITER SM-78 Army-AF-NASA
Type: SS prime: Chrysler
guide: Ford Instrument
speed: Mach 10
power: Rocketdyne range: 1,500 mi.
★ Contract with Chrysler expires April, '61. Rumored that Army may not renew.

LACROSSE SSM-A-12 Army
Type: SS power: Thiokol
prime: Martin speed: Mach 2
guide: Federal Tel. range: 20 mi.
FY '61 production funding: $8.4 million. LACROSSE is operational, now in Germany—with two battalions forming part of the NATO shield. It is multi-purpose in that it can be used against open troops as well as fortified targets.

LITTLE JOHN Army
Type: SS
prime: Emerson Elec.
guide: unguided
power: Hercules Powder
range: 10 mi.
Limited operational use with troops. Funding for FY '60 $38½ million.

LOBBER Army
Type: SS range: 15 mi.
Designed for attack and supply missions.

LOKI Army
Type: AS
prime: Grand Central Rocket
guide: unguided
power: Marquardt
Helicopter-launched anti-tank weapon. Fixed fins. Needle-nosed warhead.

LULU Navy
Type: AU prime: In House
★ LULU is a nuclear depth bomb of high priority in the fleet. Most details are classified, but it is known to be operational.

MACE TM-76 AF
Type: SS
prime: Martin
guide: AC Spark/Goodyear
power: Allison (J33-A-41)
funding: $39.8 million in FY '61. No renewal.
range: (B) 1200 mi.
★ Request funding for MACE, FY '61 totals $31½ million. Hard site launch at Cape Canaveral successful.

MAULER Army
Type: SA
prime: Convair guide: Raytheon
Anti-missile missile for field use. Truck mounted. Second phase contract has been awarded to Convair: $5½ million. Contract to Burroughs for transportable computer system.

MINUTEMAN SM-80 AF
Type: ICBM
prime: Boeing guide: Autonetics
power: Thiokol/Aerojet/Hercules Powder
range: 6300 mi. nosecone: Avco
★ Third stage production award expected momentarily. Third stage engines have been successfully test-fired. Total of $390 million to be spent on MINUTEMAN in FY '61. Hard MINUTEMAN squadrons run close to $60 million apiece.

MISSILE A Army
Type: SS
No contracts range: 70 mi.
Possibility of combining MISSILE A with MISSILE B.

MISSILE B Army
Type: SS
No contracts range: 10-20 mi.
Will replace LITTLE JOHN. Still in dvlpmnt stage.

MISSILE C Army
Type: SS
No contracts range: 70-90 mi.
Similar to SERGEANT. In dvlpmnt.

MISSILE D Army
Type: SS
No contracts range: Over 500 mi.
Now in early dvlpmnt.

NIKE-AJAX SAM-A-7 Army
Type: SA
prime: Western Electric
guide: Western Electric
power: Hercules Powder
speed: Mach 2.5 range: 25 mi.
Conversion of NIKE-AJAX sites to NIKE-HERCULES continuing rapidly in US, Europe, and Far East.

NIKE-HERCULES SAM-A-25 Army
Type: SA
prime: Western Electric
guide: Western Electric
power: Hercules/Thiokol
funding: $111.4 million in FY '61
speed: Mach 3.2 range: Over 75 mi.
Work continuing rapidly on conversion of NIKE-AJAX sites to NIKE-HERCULES. This fine weapons system appears slated for long retention in our anti-aircraft protection arsenal. Nuclear head.

NIKE-ZEUS XSAM-A-25C Army
Type: SA
prime: Western Electric
guide: Bell Telephone
power: Grand Central Rocket/Thiokol
range: 200 mi.
★ Advanced testing facilities under construction at Point Mugu. Test firings there are sched to begin early '61. Recent awards to Western Electric total $18 million for dvlpmt of components and techniques for NIKE-ZEUS.

PERSHING Army
Type: SS
prime: Martin power: Thiokol
guide: Bendix range: 300-500 mi.
★ FY '60 funding $131.6 million. First launch from self-contained transporter-erector-launcher (TEL) successful; bringing score-to-date to 5 successes out of 5 tries. Most recent contract: $30 million to Martin. ($25 million for engineering, $5 million for hardware.)

POLARIS FBM Navy
Type: US-SS
prime: Lockheed power: Aerojet
guide: GE range: 1200 mi.
★ New lightweight second stage motor by Aerojet fired successfully. Latest contract award to Northrop—$28 million for POLARIS missile system components. Total cost of $8½ billion estimated for the planned 45 POLARIS subs with missiles.

QUAIL GAM-72 AF
Type: AS-ECM prime: McDonnell
guide: Radio command/Summers
power: GE (J85) range: 200 mi.
Air-launched diversionary missile of extreme sophistication and complexity is valuable aid in protection of SAC bombers.

RAVEN XASM-9 Navy
Type: AS
No contracts announced.
range: 500 mi.
Proposed air-to-surface range: 500 mi. missile now under study. Project appears to be lagging.

REDEYE Army/USMC
Type: SA prime: Convair
guide: Convair
power: Atlantic Research
Lightweight (18 lb.) infra-red guided bazooka-type missile. Army has high hopes for this relatively inexpensive and effective, easily-carried guided missile that can be fired from a soldier's shoulder, giving him better anti-aircraft capability than ever before.

REDSTONE SSM-A-14 Army
Type: SS power: Rocketdyne
prime: Chrysler speed: Mach 5
guide: Sperry Rand range: 250 mi.
Now operational with U. S. troops in Europe. REDSTONE with TV camera has been successfully tested and fired in longest overland rocket flight ever attempted. Will use JUPITER C fuel tanks to increase range.

SERGEANT SSM-A-27 Army
Type: SS
prime: Sperry power: Thiokol
guide: Sperry range: 75 mi.
FY '61 production funding: $52.1 million.

SHILLELAGH Army
Type: SS
prime: Aeronutronics
guide: Aeronutronics
power: Picatinny Arsenal
range: 8 mi.
Gyro for complex guidance system now being dvlpd by Telecomputing. Ideal for close-in support of troops.

SIDEWINDER AAM-N-7 Navy GAR-8 AF
Type: AA
prime: Philco guide: Philco/GE
power: Hercules Powder
range: 7 mi.
★ Extremely popular infra-red homing missile is simple and rugged. SIDEWINDER-1C is advanced model with higher speed and greater range. Advanced model has interchangeable warhead—one with infrared guidance (IRA), the other with radar guidance (SARAH). All weather type SIDEWINDER, to be used on PHANTOM-2 fighter, now in R&D. Even more advanced model "Super Sidewinder" under dvlpmt.

SKYBOLT GAM-87A AF
Type: AS
prime: Douglas power: Aerojet
guide: Nortronics nosecone: GE
range: 1000 mi., a/c launch
FY '61 R&D budget set at $50 million. May be increased to allow configuration changes.

DATALOG OF MISSILE, SPACE AND DETECTION PROJECTS

MILITARY MISSILES, AUGUST 1960

★ *New information this month*

SLAM AF
Type: SS
prime: Chance-Vought
★ Supersonic Low Altitude Missile, big brother of CLAM. Chance-Vought selected as prime contractor. SLAM carries nuclear head.

SPARROW III AAM-N-6, 6A Navy
Type: AA guide: Raytheon
prime: Raytheon range: 5-8 mi.
power: Thiokol/Aerojet
Work continuing on SPARROW III with additional $26.7 million BuWeps contracts to Raytheon.

SS-10 Army
Type: SS
prime: Nord of France
weight: 33 lbs.
range: 0.9 mi.
Wire guided anti-tank weapon. Operational with U. S. and NATO forces. Used by the French in Algerian battles with success.

SS-11 Army
Type: SS
prime: Nord of France
weight: 62 lbs.
range: 2 mi.
German order of 25,000 SS-11's require full production capability of Nord. Army will cease consideration of this anti-tank weapon in favor of COBRA.

SUBROC Navy
Type: SU-UU
prime: Goodyear
guide: Librascope/Kearfott
power: Thiokol
range: 25-50 mi.
This complex weapons system is launched through a torpedo tube of a submarine or surface vessel. Rising, it flies from 25 to 50 miles through the air, then re-enters the water and homes on its submerged target. Key to perfection of the system is reliability and range of built-in sonar equipment. Work is now continuing along that line.

TALOS SAM-N-6 Navy
Type: SA guide: Bendix/AVCO
prime: Bendix power: McDonnell
range: 65 mi. speed: Mach 2.5
Unique in its integral ramjet body, TALOS is now operational aboard the guided missile cruiser GALVESTON.

TARTAR Navy
Type: SA
prime: Convair
guide: Sperry
power: Aerojet/Rocketdyne
speed: Mach 2.0
range: 15 mi.
Production increased on TARTAR missile. Will be primary armament of guided missile destroyers; secondary armament of guided missile cruisers. Improved TARTAR now in dvlpmt stage. Will have improved parts and higher energy solid propellant fuel.

TERRIER SAM-N-7 Navy
Type: SA
prime: Convair
guide: Sperry
power: Allegheny/Rocketdyne
speed: Mach 2.5
range: 10 mi.
Beam riding missile for use on larger surface ships, TERRIER has new electronic booster like cousin TARTAR. Operational with the fleet. Advanced TERRIER missiles now in increased production.

THOR SM-75 AF-NASA
Type: IRBM prime: Douglas
guide: AC Spark Plug
nosecone: GE
power: North American range: 1500 mi.
Now operational. RAF THOR units now complete with 60 birds. In its role as a research vehicle, THOR has served as an effective first stage booster, most capably shown in the THOR-ABLE lunar probe combo.

TITAN SM-68B SM-68 AF
Type: ICBM prime: Martin
guide: Bell/Am. Bosch/Sperry Rand
power: Aerojet nosecone: AVCO
range: 5500 mi./9775 mi. (Titan 2)
★GE selected to dvlp TITAN 2 reentry vehicle. Contract for several million dollars to be signed soon. TITAN 2 will be advanced version of model now being tested at Cape Canaveral. It will be launched from underground silo.

TYPHON Navy
Type: SA-SS range: 20 and 100 mi.
Under dvlpt. by Navy. New name for SUPER TALOS (long range TYPHON) and SUPER TARTAR (medium range TYPHON).

WAGTAIL AF
Type: AS
prime: Minn.-Honeywell
guide: Minn.-Honeywell
power: not releasable
This remarkable rocket will be able to follow contours of terrain and change speed in flight. WAGTAIL has been successfully sled-tested.

WEAPON ALPHA Navy
Type: SU
No contracts released
BuOrd "in-house"
Operational with the fleet, WEAPON ALPHA is rocket-powered depth charge now installed on destroyer escorts and class 931 frigates. The device will be replaced by semi-long range rocket-launched homing torpedoes, and is therefore already approaching obsolescence.

WHITE LANCE GAM-83B AF
Type: AS prime: Martin
guide: radio command Republic
power: Thiokol
Larger model of Navy BULLPUP for AF use. Now in dvlpmnt. FY '60 Funding $6½ million.

WILLOW Army
Type: SS prime: Chrysler
All information still highly classified.

ZUNI Navy
Type: AS-AA
Fuze contract released to Bulova
range: 5 mi.
Operational with carrier based a/c, ZUNI is a folding fin all-weather unguided rocket carried in multiple units. The Douglas AD a/c carry 48 ZUNIs below their wings on combat missions. The weapon is effective against pill-boxes, tanks, gun emplacements and small ships.

SPACE PROJECTS

PROJECT ADVENT ARPA
Type: Advanced Communications Satellite
prime: No contracts announced
Obj: Designed to be a global real-time repeater.
Basically same as PROJECT DECREE except for accelerated pace. Polar-orbiting satellites, such as PROJECT STEER and PROJECT TACKLE, may grow as off-shoots of PROJECT ADVENT.

AEROS NASA
Type: Meteorological Satellite
Obj: Designed to take pix of cloud formations and frontal systems.
★ Successor to NIMBUS, will be a 24 hour stationary weather satellite.

AGENA AF/NASA
Type: Liquid-fueled Upper Stage
prime: Lockheed
Obj: AGENA will be useable as a second stage to ATLAS and THOR missiles. It incorporates a Bell rocket engine similar to that used previously in the HUSTLER vehicle. The AGENA upper stage is used in DISCOVERER, MIDAS and other projects. AGENA and SATURN are part of PROJECT TRIBE.

AGENA B AF/NASA
Type: Liquid Fuel Upper Stage
prime: Lockheed
Obj: Deep Space Missions
ATLAS-AGENA B moon shot sched for mid '61. It will TV moon and land instrument capsule to tell NASA about the makeup of the moon. Shot with THOR sched this summer by AF. NASA will buy 16 Agena-B launch vehicles for $50 million.

APOLLO NASA
Type: Manner Spacecraft
prime: No contracts announced
Obj: Earth- or lunar-orbiting space lab for three men
★ Planned as next step in space exploration to follow PROJECT MERCURY.

ASTROBEE AF
Type: Space Probe Rocket
Obj: Designed for short-range space-probes
Repeated use of this handy rocket. Many missions planned for future short-range space research missions.

ATLAS-ABLE NASA
Type: Large Booster
prime: Convair/Space Tech Labs
guide: GE/Burroughs/Am. Bosch
power: Rocketdyne/Aerojet
Obj: Designed to orbit 200-lb. satellite around moon.
2 ATLAS-ABLE shots are sched for late '60. Both aimed at lunar orbit. Project going well, with much interest in this combo.

CALEB Navy
Type: Astronautics Vehicle
prime: In House
range: 13,000 mi. (horizontal)
alt: 2000 mi. (vertical)
★ Now entering instrumented test firing stage. Launched from F4D or F4H fighter a/c. Planned to launch small payloads into orbit. CALEB is planned as "a vehicle of potential operational use to the Fleet for reconnaissance, meteorological and other military missions."

CENTAUR NASA
Type: Soft-Land Moon Vehicle
prime: Convair
guide: Minn.-Honeywell
power: P&W/JPL
1st stage: Hi-energy Atlas
2nd stage: 2 P&W liquid hydrogen engines
3rd stage: JPL 6000 lb. thrust liquid engine
Obj: Designed to land 730-lb. payload on moon in soft landing, for heavy earth satellites and probes to Mars and Venus.

DATALOG OF MISSILE, SPACE AND DETECTION PROJECTS

SPACE PROJECTS, AUGUST 1960

★ *New information this month*

Static tests underway in San Diego. Full firing due early '61.

COURIER ARPA (Army)
Type: Communications Satellite
prime: Philco
Obj: Designed to be delayed repeater satellite, part of PROJECT NOTUS.
★ Launch expected momentarily.

PROJECT DISCOVERER AF
Type: Stabilized Satellites
Obj: (a) Achieve orbital capabilities of large satellite vehicles.
(b) Dvlp tech for operational military satellie systems.
(c) Recover by use of suitable re-entry capsule for biomedical and other studies.
(d) Execute nonrecoverable advanced engineering tests.
(e) Such other objectives as may be directed.
★ DISCOVERER 13 successfully recovered 11 August. Attempt to grab capsule mid-air failed.

DYNA-SOAR I AF/NASA
Type: Boost-Glide Orbiting Vehicle
prime: Boeing (for Glider)
Martin (for Booster)
guide: not announced
power: not announced
Obj: Manned glider for orbit and re-entry
FY '61 budget: $58 million. AF has also released FY '59 and '60 funds totalling $29.7 million. Boeing now constructing manned glider. Speed up on booster expected. Launch expected late '64. Soviets also working on manned edge-of-space glider.

PROJECT ECHO NASA
Type: Inflatable Satellites
Obj: Global communications experiment.
★ ECHO 1 launch of 12 August successful. ECHO 2 launch will follow.

PROJECT GREB Navy
Type: Satellite Solar Radiation Measuring System
prime: NRL
Obj: Measure solar emissions in order to provide a better understanding of the ionosphere.
★ The GREB satellite was launched into orbit with TRANSIT 2 on 22 June 1960 and separated by spring action at rate of 1.5 f.p.s. after orbit was established.
The satellite measures Lyman alpha lines and the X-ray spectrum below 8 angstroms since these are the ony ionization radiations produced by the sun that penetrate the earth's atmosphere to the levels responsible for radio wave absorption.

IRIS NASA
Type: Sounding Rocket
prime: Atlantic Research
Obj: Designed to put 100 lb. payload at 200 mi. altitude.
★ IRIS is capable of lifting 100 lbs to an altitude of 200 miles. In first test 22 July, it lifted 150 lbs 140 miles. It is a low cost rocket, each unit costing apx ½ that of comparable rockets.

JUNO II NASA
Type: Large Booster prime: Chrysler
guide: Ford Instrument
power: Rocketdyne/JPL
Obj: Attempts to put small payloads in space.
Project to be completed, 1960.

MARINER NASA
Type: Space Vehicle
Obj: Planetary missions
★ Post MERCURY project, designed for planetary voyages. May weigh close to 50,000 lbs.

MERCURY NASA
Type: Manned Satellite
prime: McDonnell
Obj: Will attempt to put man in brief orbit, then parachute him in capsule safely to earth.
guide: not announced
power: ATLAS (Rocketdyne)
★ Continual delays and failures make sched launch date doubtful.

MIDAS WS 117L AF
Type: Early Warning Satellite
prime: Lockheed
Obj: Infrared sensing of enemy ICBM launchings.
★ MIDAS would double our warning time of enemy ICBM launch, detecting heat from exhaust of missile as it is launched. ATLAS-AGENA vehicle will be used. Initial launches from Cape Canaveral—later from Point Argvello.

MRS. V ARPA
Type: Maneuverable, Recoverable Manned-Space Vehicle
No contracts announced
Obj: Will attempt to place manned vehicle in orbit, then maneuver out of original orbit in space, then return safely to earth.
This project is also known as DYNA-SOAR II. Vehicle will weigh in excess of 20,000 lbs. Launch may be from or to space.

NERV NASA
Type: Nuclear Emulsion Recovery Vehicle
prime: GE
Obj: Measurements of Van Allen Radiation belts
Initial shots expected Sept '60 with ARGO D-8 rocket. Later shots with SCOUT, not yet on calendar, designed to place 75 lb. cone-shaped payload to alt of 10,000 mi. Early shots to alt of 1800 mi.

NIMBUS NASA
Type: Meteorological Satellite
Obj: Designed to take television pictures of cloud formations and frontal systems. Will be in polar orbit, earth oriented.
Total of 10 satellites will be launched through 1965—one every 6 months. THOR AGENA-B vehicles will be used. Improved components will be used as available. Invitations to bid will be issued soon.

NOVA NASA
Type: Large Booster
prime: Rocketdyne
power: Rocketdyne
Obj: Will build 6-12 million lb. thrust booster for Outer Space
Rocketdyne's 1.5 million lb. thrust engine is heart of this system. NOVA will be cluster of 4-6 such engines. Engine in early dvlpmnt now, sched for operation after 1965.

ORION AF
Type: Rocket propelled by nuclear pulses
prime: General Atomic
Obj: Nuclear powered Outer Space Vehicle
In basic testing stage. Apx $2½ million spent to date.

PONTUS ARPA
Type: Material Research
prime: no contracts announced
Obj: Experimentation and dvlpmnt of better structural and power conversion matls for military requirements in surface, air and missile programs.
Contracts awarded to Cornell, Pennsylvania, Northwestern Universities. Total funding through 1963; $13.9 million, to establish, equip and operate laboratories. Additional labs may be set up at other universities at a later date.

PRINCIPIA ARPA
Type: Solid Propellants
prime: no contracts announced
Obj: Dvlping new solid propellants with 10-20 percent higher specific impulses.
Project studies to be carried out by universities. Contract negotiations now almost completed.

PROJECT 609A AF
Type: Hyper-Environmental Test System (HETS)
prime: Aeronutronic
guide: Minn.-Honeywell
power: Aerojet/Allegany/Thiokol
Obj: Testing equipment and techniques; collecting scientific data at space equivalent altitudes in support of ARDC mission of advancing the state-of-the-art components, subsystems, and specialized methods related to future ballistic missile and military space systems.
★ The 609A research support vehicles are a family of solid fuel multi-stage ballistic missiles incorporating basic components of the fourth-stage NASA SCOUT vehicle which are modified and arranged in various configurations to fulfill special AF requirements.

PROSPECTOR NASA
Type: Lunar Probe
Obj: Soft landing of instruments on moon

PROJECT RANGER NASA
Type: Lunar Probe
prime: Jet Propulsion Lab/Aeronutronics
Obj: Hard landing of instruments on moon
ATLAS-AGENA B will carry 800 lb. (RANGER) package to moon. The larger payload will orient the 300 lb. (TONTO) package for hard moon landing.

REBOUND NASA
Type: Communications Satellite Network
Obj: Establish series of passive satellites for global communications.
★ These multiple passive satellites will be much like ECHO, succeeding that project.

PROJECT ROVER AEC/NASA
Type: Nuclear rocket
Obj: Prove feasibility of nuclear rocket
Now in R&D. Lockheed has contract to find adequate atom resistant materials. AEC to dvlp powerplant, KIWI-A and advanced KIWI-A3. NASA to provide frame and test combined power-plant, air-frame. $100 million in funds restored to project ROVER, bringing grand total of $58 million in FY '61 funds. Will see nuclear power-plant by '63, rocket by '66.

SAMOS WS 117L AF
Type: Reconnaissance Satellite
prime: Lockheed
Obj: TV Satellite
AF has $200 million in FY '61 for SAMOS. May get additional funds up to $84 million, mostly for program speedup.

DATALOG OF MISSILE, SPACE AND DETECTION PROJECTS

SPACE PROJECTS, AUGUST 1960

★ *New information this month*

SATURN NASA
Type: Large Booster prime: Convair
power: Pratt & Whitney/Rocketdyne
Obj: Clustered 1.5 million lb. thrust booster for Outer Space Vehicles.

Douglas has contract for second stage, with propulsion grant to Rocketdyne. C-2 model SATURN should be ready in late 1960's.

SCOUT NASA
Type: Four-stage Satellite Launch Vehicle
prime: Chance Vought
guide: Minn.-Honeywell
power: Aerojet/Allegany/Thiokol
Obj: Designed to place 200-300 lb. satellites in orbit.
First stage: Modified POLARIS
Second stage: Modified SERGEANT
Third stage: Antares
Fourth stage: standard VANGUARD 3rd stage.

★ Second test of SCOUT stopped after third stage firing. No malfunction indicated, only radar signal mistake. Next test sched for end '60.

SHEPARD ARPA
Type: Tracking System
prime: no contracts announced
Obj: Tracking and data reduction

System will detect and track satellites from Space Surveillance Control Center.

SUNRISE ARPA

PROJECT SUNRISE will make studies of advanced military weapons with special concentration on space delivery.

SURVEYOR NASA
Type: Lunar Probe
Obj: Soft landing of instruments on moon

THOR-ABLE NASA
Type: Large Booster
prime: Douglas/Space Tech Labs
Obj: Designed for deep space probes of lighter payloads than ATLAS-ABLE.
guide: GE
power: Rocketdyne/Aerojet

Good reliability with this combo, as shown by success of PIONEER 5, in giving us valuable outer-space data.

THOR-DELTA NASA
Type: Satellite Launching Vehicle
prime: Douglas guide: ITT
power: Aerojet/Allegany
Obj: Designed to put small satellites (50-80 lbs.) into orbit around moon.

Use as launch vehicle, with first satellite launches mid '60 on TIROS 2 project.

TIROS NASA
Type: Meteorological Satellite
prime: RCA
Obj: Reveal certain aspects of the nature of weather

★ TIROS I is transmitting no more pix. Since its launch, 1 April, it has sent 22,952 pix, making valuable contributions to meteorological research.

TIROS 2 NASA
Type: Meteorological Satellite
prime: RCA
Obj: Provide info on nature of weather

★ Launch successful on TIROS 2 much like TIROS 1, with infra-red photo equipment. THOR-DELTA powered.

PROJECT TRANSIT Navy
Type: Navigation Satellite
prime: APL/JHU
Obj: Earth satellite system to provide accurate all-weather navigation for surface ships, a/c, and subs.

★ The operational TRANSIT Navigational System will consist of four satellites, each weighing 50 to 100 lbs. in prescribed orbits; a network of five ground tracking stations; a computing center; a data injection station, and navigating equipment. The ground tracking stations situated at known locations track the satellite and transmit the doppler tracking data to the computing center where both the orbit and predicted orbit are calculated. Predicted orbital information is transmitted to the data injection station where it is relayed to the satellite and stored in the satellite's memory device. The satellite continuously transmits its stable radio frequencies, a reference time standard signal, and also (periodically) its own orbital information. The navigation equipment is designed to receive the doppler data, time signals and orbital information from the satellite and to determine a navigational fix from these data.

Two R&D TRANSIT satellites are presently in orbit: TRANSIT 1 launched 13 April 1960 and TRANSIT 2 launched 22 June 1960.

PROJECT TRIBE ARPA
Obj: Outer Space Vehicles

PROJECT TRIBE is a research, experimentation and systems dvlpmnt designed to obtain at the earliest practical date a continuing family of military space vehicles capable of satisfying the needs for space missions as may be determined by Secretary of Defense from time to time. Guidance, stabilization and control components necessary to satisfactory performance of the vehicles shall be included in the scope of this assignment. The SATURN Task and AGENA Task are part of Project TRIBE.

VOYAGER NASA
Type: Advanced Spacecraft
Obj: Various planetary missions

★ More advanced craft than the planned MARINER vehicle.

X-15 AF/Navy/NASA
Type: Rocket-Powered Manned Aircraft
prime: North American power: Thiokol
Obj: Designed to take man in controlable a/c to fringes of outer space—250,000 ft. altitude, at speed of Mach 5 (better than 3600 mph.).

★ Almost back on sched now, with record-breaking 2150 mph flight of 4 August.

PROJECT YO YO Navy
Type: Reconnaissance Satellite

★ This study has been dropped by Navy.

DETECTION PROJECTS

BALLISTIC MISSILE DEFENSE BMEWS AF
Type: Ballistic Missile Defense Radar System
prime: RCA
Obj: Ballistic Missile Early Warning System designed for 40-minute notice of approaching enemy ICBMs.

★ R&D cost of BMEWS—$700 million. Production and construction costs will total $180 million. Estimated total cost upon completion is $1 billion.

PROJECT DEFENDER ARPA
Obj: Ballistic Missile Defense

ESAR, TRADEX and PINCUSHION are only part of the entire ballistic missile defense program of ARPA. The GLIPAR studies, (Guide Line Identification Program for Anti-Missile Research) is also a part of Project DEFENDER.

ESAR ARPA
Type: Advanced Warning Radar
prime: Bendix
Obj: Electronically Steerable Array Radar is designed for ground installation to warn of approaching enemy missiles. Multitude of individual cells will give more flexibility than other systems of steerable radar. Part of PROJECT DEFENDER.

GLIPAR ARPA
Type: Study Group for Missile Defense
Obj: Designed to work on future ICBM defense. Called upon by DEFENDER and LONGSIGHT.

PROJECT LONGSIGHT ARPA
Type: Study System in Missile/Space Field
Obj: Recommendations as to projects which should be initiated to satisfy future military requirements. GLIPAR (Guide Line Identification Program for Anti-Missile Research) which was initiated. GLIPAR is now used by both LONGSIGHT and DEFENDER. LONGSIGHT more advanced than DEFENDER.

PINCUSHION ARPA
Type: Advanced Radar prime: Raytheon
Obj: PINCUSHION is a many-frequency radar installation to be located on Kwajalein in the Marshall Islands, initially, as an early warning radar of a more variable type than TRADEX or ESAR.

SAGE AF
Type: Continental air warning and control network
prime: IBM
Obj: Provides a push-button missile defense utilizing a search radar system to locate enemy aircraft and destroy them with integrated BOMARC missiles.

PROJECT SPASUR ARPA
Type: Space Surveillance System
prime: NRL/Bendix
Obj: To produce a system capable of detecting, identifying, and determining orbits of non-radiating objects in space.

★ The feasibility and operational capability of SPASUR has been demonstrated. A need now exists to increase the detection range and data handling capability of the system.

PROJECT TEEPEE Navy
Type: Long Range, High Frequency Radar
Obj: Provide ICBM detection

TRADEX ARPA
Type: Advanced Radar
prime: RCA
Obj: TRADEX is a modification of the radar types designed for BMEWS. It has better range.

VELA ARPA
Obj: Research, experimentation and systems dvlpmnt related to the nuclear test moratorium.
VELA Uniform: R&D on sub-surface nuclear explosion detection. Funding for FY '60: $8,535,000.
VELA Sierra: R&D on ground detection of nuclear explosions in space. Funding for FY '60: $1,050,000.
VELA Hotel: R&D on satellite detection of nuclear explosions in space. Funding for FY '60: $300,000.

★ 16 study contracts in seismological research released July to universities. 8 more to be released in same field.

DATA's 1960-61 SCHEDULE

	1960	1961
JANUARY	Air Research & Development Command (ARDC)	Air Research & Development Command (ARDC)
FEBRUARY	Bureau of Naval Weapons (BuWeps)	Bureau of Naval Weapons (BuWeps) and Bureau of Ships (BuShips)
MARCH	National Aeronautics & Space Administration (NASA)	National Aeronautics & Space Administration (NASA)
APRIL	Navy Supply System	Federal Aviation Agency (FAA)
MAY	Army Ordnance Corps	West German Defense
JUNE	Air Materiel Command (AMC)	Air Materiel Command (AMC)
JULY	Navy Anti-Submarine Warfare (ASW) Program	Navy Anti-Submarine Warfare (ASW) Program
AUGUST	Navy Astronautics Program	Air Force Electronics Program (Rome ADC & AFCCDD)
SEPTEMBER	Army Signal Corps	Army Signal Corps
OCTOBER	Army Research & Development Program	Army Transportation Corps
NOVEMBER	German-American Defense in the Mutual Security Program	Army Ordnance Corps
DECEMBER	Department of Defense Annual	Department of Defense Annual

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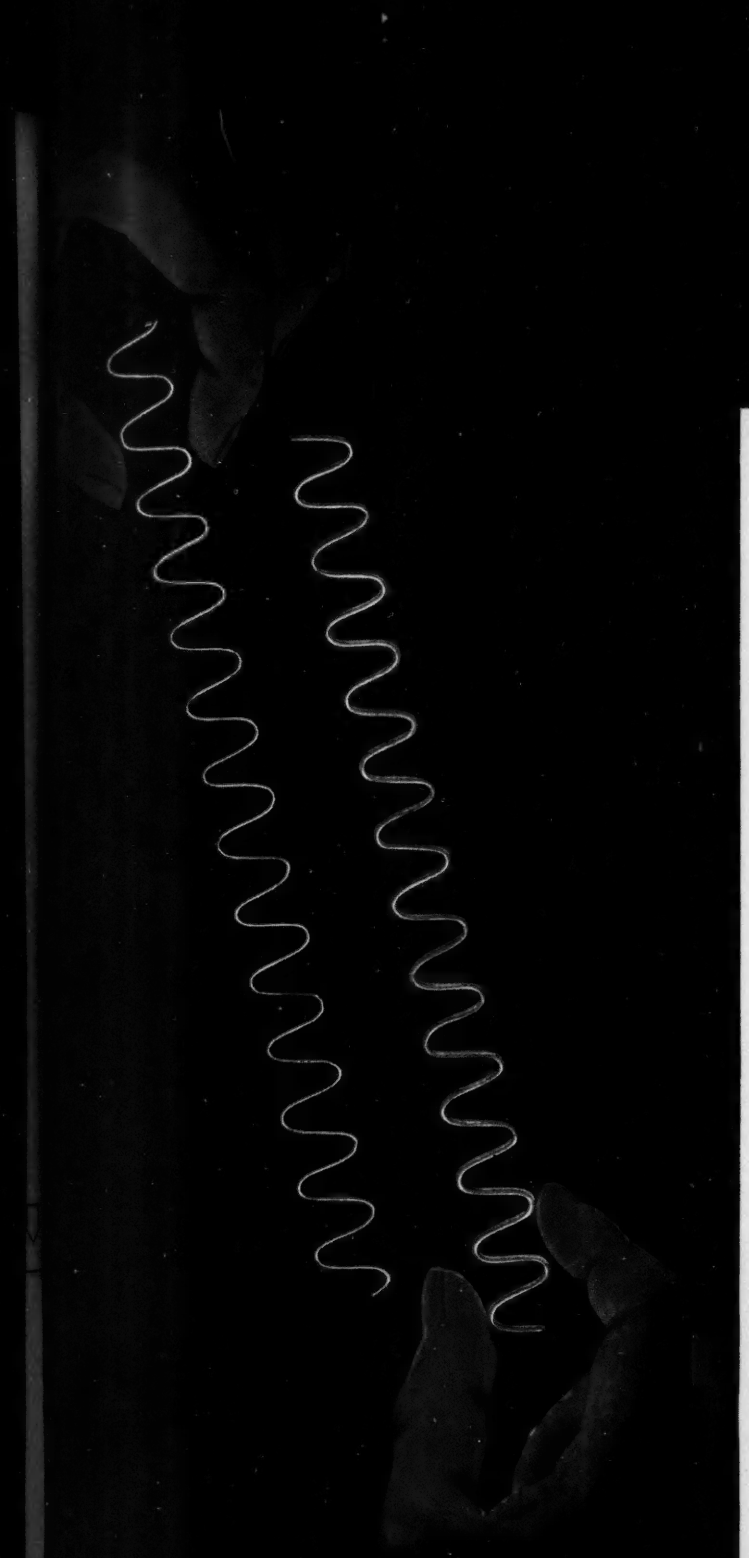

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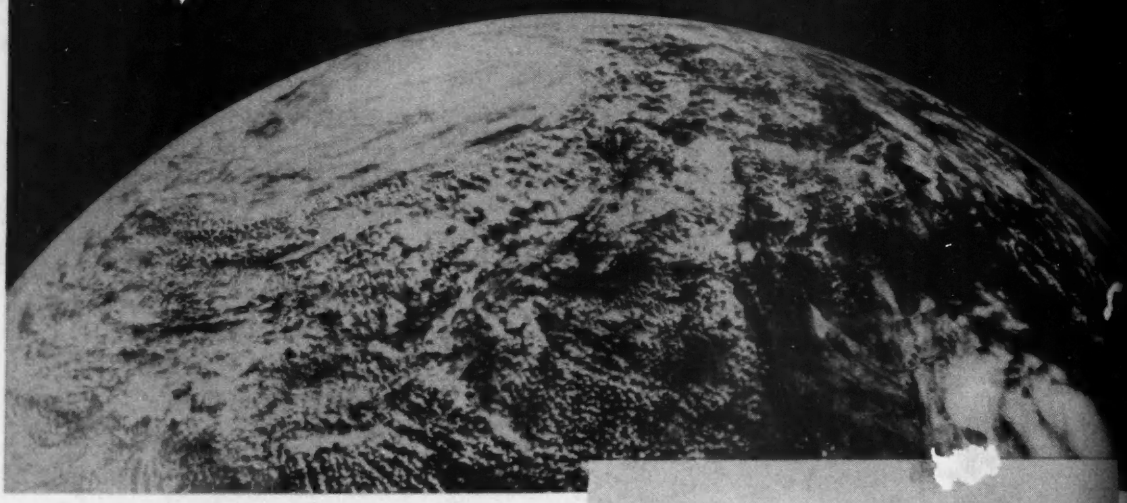

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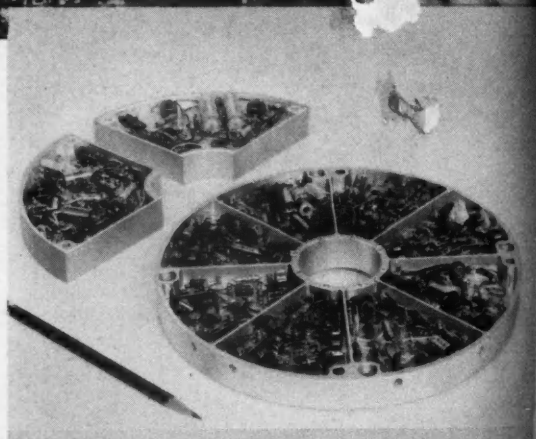

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